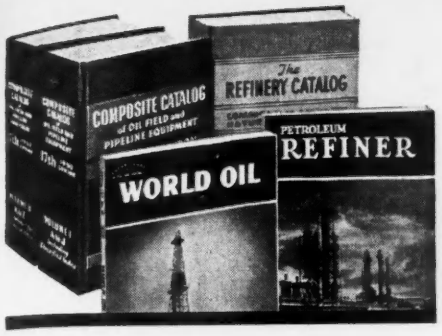


Specialized Oil Publications of
THE GULF PUBLISHING COMPANY
3301 Buffalo Drive, Houston 6, Texas
Box 2608, Houston 1, Texas

WORLD OIL and The COMPOSITE CATALOG
for the drilling-producing-pipe line industry

PETROLEUM REFINER and The REFINERY CATALOG
for the refining-natural gasoline industry

RAY L. DUDLEY, *President, Publisher*
A. L. BURNS, *General Manager*
WARREN L. BAKER, *Editorial Director*

EDITORIAL STAFF

WARREN L. BAKER, *Editor*
AL REESE, *Managing Editor*
L. J. LOGAN, *Associate Editor*
ELTON STERRETT, *Engineering Editor*
CECIL W. SMITH, *Statistical Editor*
MARK OLSON, *International Editor*

DISTRICT EDITORS

J. E. KASTROP, 3301 Buffalo Drive, Houston 6, Texas
HENRY OZANNE, 250 Park Ave., New York 17, N. Y.
GILBERT M. WILSON, W. W. Wilson Bldg., Huntington Park, Calif.
ANTHONY GIBBON, Hunt Bldg., Tulsa 3, Okla.
MARION DENNARD SYLVIA LILLIE
RUTH THOMPSON
Editorial Assistants
MARY A. ZUBER, *Librarian*

ADVERTISING STAFF

TOM W. NELSON, *Advertising Manager*
ROGER MOTHERAL, *Eastern Advertising Manager*
250 Park Ave., New York 17, N. Y.
NELSON BIGELOW, 250 Park Ave., New York 17, N. Y.
BILL WESTFALL, 1010 Euclid Ave., Cleveland 15, Ohio
H. G. FITZPATRICK, 332 S. Michigan Ave., Chicago 4, Ill.
BILL ATCHESON, Hunt Bldg., Tulsa 3, Okla.
J. W. CURTS, W. W. Wilson Bldg., Huntington Park, Calif.
CHARLES WYATT, 3301 Buffalo Drive,
DOUG CRAIG, 3301 Buffalo Drive
FRANK MURPHY, 3301 Buffalo Drive
Houston 6, Texas

CIRCULATION DEPARTMENT

R. M. DE SOMBRE, *Manager*

Single copies 50 cents (except special issues). Subscription price: domestic and foreign, $2 a year; 2 years, $3; 3 years, $4. WORLD OIL, published every month except semi-monthly in February and July. Entered as *The Oil Weekly* as second class mail matter December 23, 1916, at the post office at Houston, Texas, under the act of March 3, 1879. Advertising rates on application. Copyright, 1951, by The Gulf Publishing Company.

Indexed by Industrial Arts Index and Engineering Index

Review-Forecast Issue
Coming February 15

This special issue of WORLD OIL will bring you a complete review of 1950, plus forecasts for '51. To get a personal copy, send us the coupon on page 245.

ABC WORLD OIL ABP
Established 1916 as THE OIL WEEKLY

CONTENTS

February 1, 1951 **Vol. 132, No. 2**

CURRENT OUTLOOK SECTION

Looking Ahead ... 19
Publisher's Page ... *Ray L. Dudley* 21
The Changing Panorama ... 23
Report from the Observatory ... *Ray L. Dudley and Warren L. Baker* 24
Petroleum Trends ... *Cecil W. Smith* 26
Monthly News Analysis ... 29
The Month's Completions ... 34
Fewer Flares Light Texas Skies ... *L. J. Logan* 39
The Giants Came Home ... 41
Oil Joins Other Industries in Upholding Free Enterprise ... *Henry Ozanne* 44
Bureau of Mines Role in Secondary Recovery (Part 2) ... *R. A. Catell* 50

EXPLORATION SECTION

New Method Logs Dip and Strike of Subsurface Formations ... 57
A Two-Level Aeromagnetic Profile Across Western Texas ... *H. Wayne Hoylman* 62
Petroleum Geology Pioneered in Tennessee ... 66
Regional Study Reveals Colorado Oil Prospects ... *Dr. Clark F. Barb* 72
1950 Exploration 13 Percent Above Record ... 76

DRILLING SECTION

Anti-Earthquake Damage Operations ... *D. L. Roberts* 83
WORLD OIL Graphics: Cutting Wire Line ... 88
Unusual Causes of Steam Pump Troubles ... *Roy E. Edwards* 89
Portability and Compactness Feature Generator House and Mud Tank Units ... *Gilbert M. Wilson* 96
Pontoon Ferry Eliminates Expensive Bridging Operation ... *Elton Sterrett* 98
Substructure Design Reduces Rigging Time ... *John C. Albright* 100
Reverse Circulating of Drill-Stem Tests in Open Hole ... *J. E. Smith* 102
Drilling Safety Factors Cited ... 104
Coddle That Cathead! ... *Ben F. Kelley* 106
Care and Maintenance of Wire Rope ... *R. D. McNutt* 108
Engine Shelter Supports Speed Disassembly ... 115
How to Do It—Drilling Hints ... 120

PRODUCTION SECTION

Applications and Results of the Hydrafrac Process ... *W. E. Hassebroek* 133
Electric Log Resistivity, Porosity and Water Saturation for Clean and Shaly Sandstones ... *Park J. Jones* 140
Open Flow Potential Calculation for Dual Completion Wells ... *C. W. Binckley and W. L. Hixon* 150
Protection of Well Casings Against External Corrosion ... *R. E. Hammond and S. P. Ewing* 154
Elements of Dynamometer Tests ... *David S. Stear* 160
How to Do It—Production Hints ... 165

PIPE LINE SECTION

Novel Sighting Method Cuts Survey Time ... *E. Eugene Howe* 175
River Crossing Span Lifted as Single Unit ... *Gilbert M. Wilson* 180
Underground Storage of a Propane-Air and Natural Gas Mixture ... *H. L. Fruechtenicht and John B. Simpson* 183
Pipe Line Construction ... *Sylvia Lillie* 191
How to Do It—Pipe Line Hints ... 194

INTERNATIONAL SECTION

Kingdoms of Oil: Kilgore, Texas (First of a Series) ... *Joseph P. Ellis* 201
New Technique Taps Athabaska Tar Sands ... *Dr. K. A. Clark* 205
Reservoir Engineering: Leduc D-2 Zone Pool (Second of Three Parts) ... *James E. Baugh* 210
Aramco Spuds First Offshore Test ... *Henry Ozanne* 216
Shot Hole Drilling in Canada ... *W. A. Burggren* 217
Philippines Look to Increased Oil Activity ... *Demetrio Andres* 220
Middle East Pattern Changed: Aramco Makes Deal . . . Iran Talks Fail ... 226

OTHER DEPARTMENTS

The Oil Man's Calendar ... 16
New and Improved Equipment Supplementing Composite Catalog ... 228
Other New and Improved Equipment ... 236
New Literature ... 240
Men in the Industry News ... 242
Companies in the News ... 249
Associations ... 250
Equipment and Service Suppliers' Notes ... 253
Trading Post (Classified Advertising) ... 258
New Books, Maps and Movies ... 259
Squeaks from the Bullwheel ... 260

ADVERTISERS' INDEX

* Asterisk preceding name of advertiser indicates that detailed data on products and services of the firm will be found in current 17th (1950) edition of The Composite Catalog of Oil Field and Pipe Line Equipment.

A

*Acme Fishing Tool Co. 244
Aero Service Corp. 219
*Aetna Ball and Roller Bearing Co. 234
*Altens Foundry & Machine Works, Inc. 252
*American Cable Division
American Chain & Cable Co. 59
*American Iron & Machine Works Co. 103
*American Manufacturing Co. of Texas 4
*American Sand-Banum Co. 172
American Steel & Wire Co. 47
*Axelson Manufacturing Co. ..... 143, 163 and 233

B

*B & W, Incorporated 250
*Baash-Ross Tool Co. 105
*Baker Oil Tools, Inc. ..... 22 and 212-213
*Baroid Sales Division
National Lead Co. 200
Wm. M. Barret, Inc. 256
*Beaver Pipe Tools, Inc. 233
*Bethlehem Steel Co. ..... 8, 49 and 107
*Big Four Machine & Supply Co. 248
*Black, Sivalls & Bryson, Inc. 144-145
The Bovaird Supply Co. 132
*The Brewster Co. 31
*Bucyrus-Erie Co. 73

C

Cable & Stine 172
*Cameron Iron Works, Inc. ..... 56 and 82
*Cardwell Manufacturing Co. 110-111
*Catawissa Valve & Fittings Co. 236
*Caterpillar Tractor Co. 43
Chicago & Southern Air Lines 253
Dan L. Clark Drilling Co. 230
*Clark Bros. Co. 177
*Coffing Hoist Co. 260
Continental Oil Co. 169
Core Laboratories, Inc. 114
*Crane Co. 25

D

*The Dayton Rubber Co. 69
*Diamond Chain Co. 167
Dowell Incorporated 20
*Dresser Industries, Inc. ..... 70-71, 157, 177 and 251
*Dresser Manufacturing Division
Dresser Industries, Inc. 251
*Drilling & Service, Inc. 109
*Drilling Equipment Mfg. Co. 260
E. I. du Pont de Nemours & Co. 53

E

The Eagle-Picher Co. 254
E. H. Edwards Co. 129
Empire Trust Co. 224
*Enardo Manufacturing Co. 163

F

First National Bank & Trust Co. 231
*Fluid Packed Pump Co. 137
The Fluor Corp. 159
Fuller Co. 195

G

*Gaso Pump & Burner Manufacturing Co. 173
General Geophysical Co. 55
General Motors Corp. 161
The Geolograph Co. 128
Globe Sales Co. 172
*Goodall Rubber Co. 127
The B. F. Goodrich Co. 9
The Goodyear Tire & Rubber Co. 5
*H. P. Gott Manufacturing Co. 226
Great Lakes Carbon Corp. 77
Grove Regulator Co. 179
Gulf Oil Corp. 67
*The Gulf Publishing Co. 227

H

*Halliburton Oil Well Cementing Co. 28
*Harbison-Fischer Mfg. Co. 164
*Harrisburg Steel Corp. 255
*Hercules Tool Co. 168
*Hinderliter Tool Co. Division
H. K. Porter Co. 122
Houston Laboratories 256
*Hughes Tool Co. ..... I Cover, and 199
*Hutchison Manufacturing Co. 124
Hyatt Bearings Division
General Motors Corp. 161

I

*International Harvester Co. ..... 182 and 239
The International Nickel Co. ..... 15 and 51

J

Jefferson Union Co. 232
*Jensen Brothers Manufacturing Co. 170
Johnston Oil Field Service Corp. 237
*The S. M. Jones Co. 147
Earle M. Jorgensen Co. 263

K

Kaiser Steel Corp. 6
Kern Directional Drilling Corp. 130
*King Oil Tools 240
*Kobe, Inc. 157

L

Lakewood Hotel 256
*Lane-Wells Company. 33, 81, 209, 262 and III Cover
*Larkin Packer Co. 241
Lawn Hotel 256
*The Layne and Bowler Co. 12
A. Leschen & Sons Rope Co. 125
*Link-Belt Co. 3
*A. M. Lockett & Co. 333
Loma Alto Hotel 256
Lone Star Tool Co. 126
*Lufkin Foundry & Machine Co. ..... II Cover
Lynn Hotel 256

M

*Magnet Cove Barium Corp. 70- 71
*Manhattan Rubber Division
Raybestos-Manhattan, Inc. 14
*Jas. P. Marsh Corp. 221
*McCullough Tool Co. 261
*McKissick Products Corp. 264
*Mid-Continent Supply Co. 262
*Miller Sand Pump Co. 168
*Mission Manufacturing Co. ..... IV Cover
*Lee C. Moore Corp. 91

N

National Bank of Tulsa 75
*National Lead Co. 200
*The National Supply Co. 35-36-37- 38
*National Tank Co. 139
*New York Belting & Packing Co. 116-117
*Nordstrom Valve Division
Rockwell Manufacturing Co. 94- 95
*W. C. Norris, Manufacturer, Inc. 235

O

*Oil Base, Inc. 119
*Oil Center Tool Co. 225
*Oil Well Manufacturing Corp. 259
*Oil Well Supply Co. 229
*Otis Pressure Control, Inc. 153

P

Pacific Coast Borax Co. 166
Parelex Corp. 242
*Parkersburg Machine Co. 252
*The Parkersburg Rig & Reel Co. 223
Pelican Well Tool & Supply Co. ..... 256 and 264
Petroleum Distributing Co. 242
Petroleum Electric Power Association 190
Piper Aircraft Corp. 171
Pittsburgh Coke & Chemical Co. 257
*H. K. Porter Co. 122
Property Credit Corp. 232

R

*Raybestos-Manhattan, Inc.
Manhattan Rubber Division 14
*Reed Roller Bit Co. 17
Republic National Bank of Dallas 193
*Reynolds Specialty Co. 256
*The Ridge Tool Co. 249
*Rockwell Manufacturing Co. ..... 13 and 94- 95
John A. Roebling's Sons Co. 11
The Royal Bank of Canada 247

S

*S & R Tool & Supply Co. 252
*Schlumberger Well Surveying Corp. 113
Second National Bank of Houston 10
Seismograph Service Corp. 18
*Shaffer Tool Works 65
Sheffield Steel Corp. 196
A. O. Smith Corp. 187
Southern Engine & Pump Co. 163
*Southern Mill & Manufacturing Co. 238
Standard Pipeprotection, Inc. 197
*Standco Brake Lining Co. ..... 128 and 242

T

*Templeton, Kenly & Co. 130
*Thermoid Co. 123
*Thornhill-Craver Co. 189
The Torrington Co. 79
The Trading Post 258
*Tretolite Co. 131
Trojan Construction Co. 198
*Tuboscope Division
Tubular Service & Engineering Co. 149

U

*Union Wire Rope Corp. 246
*Unit Rig & Equipment Co. 61
United States Steel Corp. ..... 47 and 229

V

*Victaulic Company of America 16
*Visco Products Co. 7

W

*W-K-M Company, Inc. 243
*Waukesha Motor Co. 185
Welex Jet Services, Inc. 93
*Wheeling Machine Products Co. 192
*Wilson Manufacturing Co. 87
*Wilson Supply Co. 121
World Oil 245

Y

The Youngstown Sheet & Tube Co. 174

Looking Ahead

MATERIAL ALLOTMENTS will get keenest attention of drilling contracting industry. Needs of contractors (who did $840 million worth of business in 1950) must be fully met if they are expected to turn out nearly 88 percent of footage being drilled in U. S.

MATERIALS CONTROL PLAN regulating steel on industrial priority basis appears inevitable, may be adopted within two or three months. Confusion under present system indicates this will be necessary to assure steel for defense industries.

U. S. CRUDE PRODUCTION to be 2½ billion barrels in 1965. So says U. S. Bureau of Mines in forecasting nation's energy requirements that year will be 20 percent more than in 1947. Motor fuel consumption in 1965 will be 36 percent greater than in 1947. Study ignores atomic and solar energy.

OIL AND GAS CONSERVATION law for Utah is possibility this year. Director of geological survey proposed that governor submit a conservation statute patterned after laws in other oil producing states.

MORE TANKERS will be needed. Enlargement of tanker fleets is being pushed. Virtually whole world fleet is being employed to meet present peak demands. Tanker transportation is potential bottleneck in supplying for war.

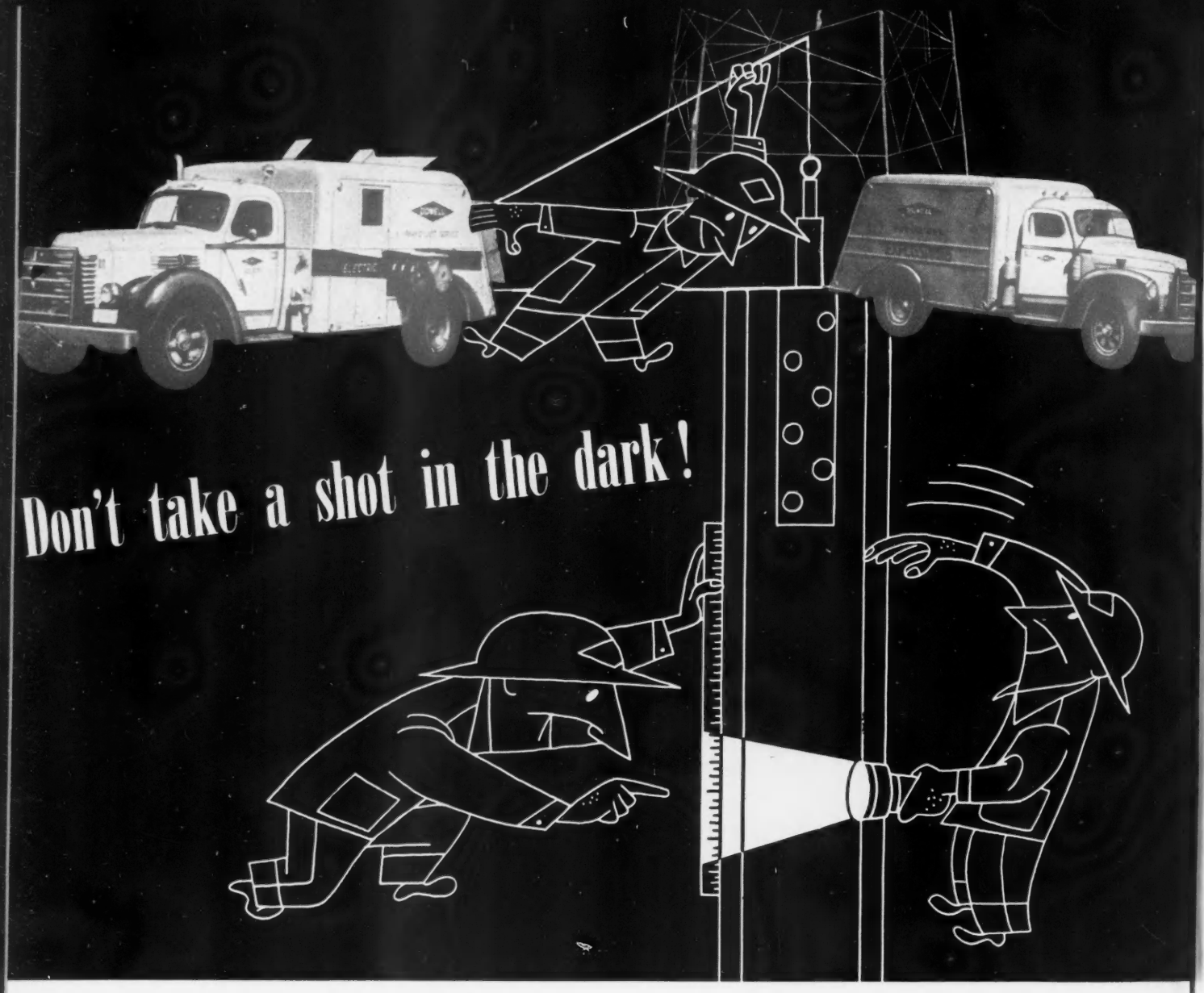
TECHNIQUES WHICH MAY revolutionize secondary recovery practices are being developed in Eastern oil fields. Experiments with gas injection into a depleted reservoir before water-flooding indicates recovery of more than 50 percent of "secondary" oil. Procedure involves establishment of a high free gas saturation in the oil sand, the gas drive acting as a broom by cleaning formation.

U. S. WILL UNDERTAKE large-scale use of Zeppelin-type airships for transporting large loads of fuel or passengers if advice of P. W. Litchfield, chairman, Goodyear Tire & Rubber Company, is followed. Nation already has underway strong blimp program, using greatly improved ships of that smaller type.

ADAPTATION OF ELECTRONIC TESTER for mine haulage ropes so it can be installed on a derrick to check actual pull in pounds on lead line to drawworks should provide invaluable data on wire rope performance. Truck mounted unit operated through electromagnetic qualities of wire line, is sensitive to both internal and external stresses. Cyclograph charts record changes, permit detailed study of rope without slowing operations or in any way affecting the wire rope.

NEW COAL PRICE HIKE is likely. Soft coal producers are expected to grant a 20-cent hourly wage boost to 370,000 miners and increase would be passed on to consumers.

SHORTAGE OF ENGINEERS in all industries will grow more critical as defense program expands. U. S. needs 30,000 new engineers annually to replace those who die or retire. But 1951 will be last year for some time that many emerge from colleges. By 1954, only 12,400 engineers will receive sheepskins.



DOWELL PERFO-JET SERVICE... An improved, more effective method of perforating casing and open hole shooting

Dowell Perfo-Jet Service offers you a bonus beyond a better means of oil well perforating. Dowell Perfo-Jet Service is conducted from Electric Pilot Service trucks, engineered and built by Dowell. This proved equipment incorporates the latest scientific instruments designed to do the job *accurately*, effectively, quickly. Also, the other Pilot Services—Caliper, Water Locating and Permeability Surveys—may be correlated with Perfo-Jet to improve the possibilities of a successful completion.

The high velocity gas jets of Dowell Perfo-Jet Service are used to give deeper, more definite penetration of casing, cement and formation . . . to increase the drainage area of tight wells completed in the open hole . . . and to increase the effectiveness of acid and other well treating chemicals by providing entry channels.

Nearly two decades of experience in oil field service have given Dowell the familiarity with well conditions and problems that is essential to good service. For more effective perforating, call Dowell Perfo-Jet Service.

DOWELL INCORPORATED
TULSA 3, OKLAHOMA
Subsidiary of The Dow Chemical Company

DOWELL
PERFO-JET SERVICE

Ask your nearest Dowell station for complete information on these Dowell Services and products: Acidizing Service, Electric Pilot Services, Plastic Service, Chemical Scale Removal Service for heat exchange equipment, Jelflake, Paraffin Solvents, Magnesium Anodes for Corrosion Control and Bulk Inhibited Hydrochloric Acid.

"Petroleum Promotes Progress"

Look to **DOWELL**

FOR OIL INDUSTRY CHEMICAL SERVICE

WHEN WE REFLECT

THE ACTION of the British Labor government, backed up in part at least by the governments of some of the Dominions, in urging what in effect would be a Communist China settlement of the Korean question, is so startling that it makes one wonder how short, indeed, is the memory of the leaders in these governments. Only the refusal of the obstinate Chinese Reds kept the deal from paying off.

No one can read the accounts of tremendous aid, in every form, given by America to England in her hour of danger, as shown in the account of her Prime Minister during World War II, without feeling that surely America established a bond of friendship between herself and the British Dominions which could never be broken. And as time wore on, American land power, followed the extension of material and sea power and the very life blood of America, herself, mingled with that of the Empire. We can understand Soviet Russia's forgetting—a hog has no conscience with which to reckon—but England! Sadly America sees that in the minds of a Socialistic government, even in England, obligations of help and blood are forgotten. It will be noted that we have said "government" and not England.

• • •

CAN THOSE who form the English and Dominions governments think that such action as we now see isn't building higher and higher the feeling beginning to take hold in the U. S. A. that the help of such Allies is of such dubious value that we might as well resolve to depend solely upon ourselves? Or are they blind to the consequences of their going it alone?

Do these incompetents in England and in some of the Commonwealth governments, who intentionally or otherwise play Russia's game, forget that only a month before Stalin began mouthing his plea for a "second front," England was not sure that Russia would not actively enter into the war on the side of the Nazis?

• • •

Of course, America has her blockheads, too. Probably they are tarred, at least somewhat, with the Socialist brush, or to change the metaphor, are slightly pregnant with socialism. In some, the pregnancy is far advanced.

THERE IS SURELY coming a reckoning. The impact of the totalitarian barbarism which goes by the name of Communism, plants too heavy a foot on the necks of non-Russians in satellite countries and on non-Communists in Russia. The union man in America, or elsewhere for that matter, if he will take but a moment for reflection and study, will easily picture his plight under the Commissars and if he selfishly should aspire to be a Commissar, he will find his radical leader in the job ahead of him! The farmer has but to recall the fate of the farmers owning land in Russia. The owners of any business, the employees of any business, the artist, the musician, the professor with a mind of his own—all have had their fate under Communism well foretold in what has happened to people like them in satellite countries and in Russia herself.

• • •

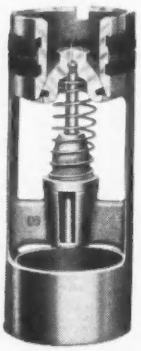
THERE WILL be few students of history who will concede that the present British Labor-Socialistic government even remotely approaches in quality the British government of World War II and few thinking Americans can be proud of the accomplishments of the pro-Socialistic forces, including Harry Truman, during the past three years. Nor will the majority of Americans fail to see through his efforts to socialize America under the guise of fighting Russia.

• • •

IN FEDERAL COURT in Houston some months ago, a Communist facing a charge of deportation said his party welcomes Socialism because it leads to Communism. When Americans accept this truth, then the semi-socialists who would convert a land of plenty into a land of planned scarcity—or at least a land of scarcity whether planned or no—then will fall the political heads of the Socialists in Democratic or Republican clothing, and the weak-kneed, subservient and in some instances senile hangers-on in the Democratic party who put party above the lives and welfare of those who elected them to office.

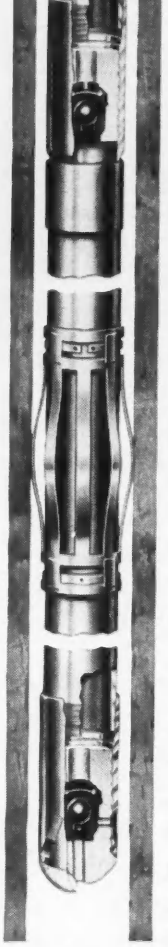
Ray L. Dudley

Don't waste time and money hauling kinked Kellys and bent drill pipe to the shop, with possible new damage while transporting and handling. The Baker Portable Kelly and Pipe Straightener does the job while the Kelly or pipe is vertically suspended through the table.

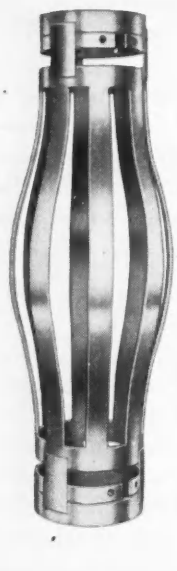


Baker BAKWIK Drill Pipe Floats make life much better for drilling crews, and profits better for contractors. No wet strings—no clogged bits—less wear and tear on wire lines and rig equipment.

You will have "BETTER RESULTS WITH BAKER"



Here's your best bet for successful "first-time" cementing . . . a Baker WASH-DOWN WHIRLER Float Shoe centered in the hole by a Baker Casing Centralizer. If the string is exceptionally long, or you want maximum safety, run a Baker Float Collar up the string. If the back-pressure valve in the Float Collar is sufficient for an average length string, run a Baker WASH-DOWN WHIRLER Guide Shoe on bottom.



Almost every drilling contractor knows that when casing is centered with a Baker Casing Centralizer, it it *really centered*, and the chances are much better for a successful "first-time" water shut-off.

No need to put up with torn swab rubbers, or damaged rubber packing elements on testers or retainers. A Baker ROTO-VERT Casing Scraper, run on drill pipe, or a *wire line*, will leave your casing free from bullets, gun-shot burrs and hardened cement.

the BEST of Luck Always!

BAKER OIL TOOLS, INC.

HOUSTON • LOS ANGELES • NEW YORK

The Changing Panorama

The Press Had a Part In Oil's Progress

WE CANNOT help feeling that somewhere in the celebration of the 50th Anniversary of Spindletop, there should have been some consideration of the part played by the press—oil press and Southwestern or national newspaper press, in the development of Southwestern oil.

For it has been an active part, and a liberal part. If the contribution made by the oil press alone to the oil industry during the past 50 years were suddenly pulled out, there would be a void most difficult to fill.

As we listened at the final banquet to a Chamber of Commerce official paying tribute to everyone from a building contractor to the local fire department, we could not tie our mind down to the happenings of the day and the week.

From the dead past whose accomplishments were being celebrated, we recalled Holland Reavis, who came to see the Spindletop boom and stayed to found two great oil publications; "Old Silvertop" Andrew Jackson Hazlett, beloved of all his fellow workers and all who knew him; P. L. McGreal, whose best work was in the formative years more than a decade after Spindletop; D. A. Dennison; Perry Scranton, who two weeks before the celebration had planned to attend, but whose life was cut short ten days before the anniversary; Patrick Boyle, who built so well on what Holly Reavis had founded and whose grandson is carrying on so ably today.

These men and others who have worked with them were of the nature of the oil men of their day just as their successors are of the nature of oil men of this day.

Without envy, having access to priceless secrets but never abusing the privilege for personal gain, their integrity was like refined silver. Striving earnestly for accuracy, giving praise where praise was due but courageously opposing that which they felt was detrimental to the industry, these men, too, have had a part.

Today those who have succeeded them, be they in the industry press or in the daily newspaper press, have brought to the benefit of the oil industry a continued striving toward accuracy and scope of vision. These things have matured mightily in the past decades and are assets which it is not well for the industry to overlook. But they had their foundation in the men whose names have been recited.

Industry Must Keep Its Skilled Manpower

WITH THE present national security emergency having all the earmarks of becoming the most severe and prolonged in the history of the U. S., the demand on oil may attain tremendous proportions. Availability of manpower, as well as steel, will determine how well the petroleum industry is able to meet the burdens which may be thrust upon it during this national crisis.

The great deal of attention being given the industry's steel problem lends encouragement that oil will receive its fair share of the supply available for critical industries. However, skilled manpower is just as essential in providing adequate oil supplies. Yet, to date little attention has been given to establishing regulations which will prevent the loss of trained men. With mobilization henceforth to be at an accelerated pace, manpower could easily and quickly become acute as men go to work in shipyards, plane factories and munition plants.

During the early stages of World War II there were indifferences toward holding the oil industry's skilled manpower, and too many trained men drifted to other defense industries. It is to be hoped that this time oil from the very beginning will receive the same consideration with reference to military deferment as is given to other critical industries.

Now, while the over-all problem of manpower still is in a highly indefinite transition period, is the time to consider the needs of all critical industries so as to avoid the loss of men who can contribute more to the war effort by remaining on present industrial jobs.

Recognition of oil's need for trained men is too imperative to the defense effort for the industry to be slow or hesitant in trying to establish its importance. Industry associations like The American Petroleum Institute, the Independent Petroleum Association of America, the Association of Oil Well Drilling Contractors, and the Mid-Continent Oil & Gas Association should be presenting the problem to the proper military and government authorities in Washington. OIIC and PAD are other organizations that could assist in this important effort.

In view of the greater military appreciation of the significance of oil to the defense effort, such efforts likely would meet with success.

Continental Pictures Its First 75 Years

WE LIKE the way Continental Oil Company handled its "First 75 Years" in a pictorial booklet.

It is difficult to realize that the modern, streamlined Continental Oil Company was selling refined products in the Mountain states when Custer made his last stand.

The booklet, following the conversation of a retired Conoco man talking to his grandson, takes the reader, by pictures and words, through the years —75 of them—and brings him down to the ground-breaking "for another 75 years."

An excellent piece of work.

Oil's On Spot When Treasury Is Clean

ANOTHER "soak the rich oil man" piece of legislation looms for Oklahoma oil producers. The Oklahoma Legislature is considering a soldier's bonus measure and looking for ways to finance it. Proponents of the measure, which, incidentally, has strong opposition among veterans, have recommended slapping a severance tax of 10 cents a barrel for ten years on all oil produced in Oklahoma regardless of gravity. They estimate this will bring in $100 million, sufficient to pay bonuses to more than 290,000 Oklahoma veterans of World Wars I and II as well as to Oklahomans now fighting in Korea or who may fight in any other theater within the next few years.

Report from the Observatory

Peak Demand Enhances Outlook

By RAY L. DUDLEY, Publisher, and WARREN L. BAKER, Editor

WITH PEAK DEMAND resulting from the coldest weather in three winters, sizable drafts have occurred in recent weeks on both crude and distillate stocks despite record operating levels. Consequently, the industry's already favorable economic position showed further improvement during the past month. So great was the increase in consuming rates, the industry found it necessary to take steps to meet the situation, boosting refinery runs to all-time levels and also setting February crude production at the highest rates in history.

The very favorable present condition of the industry warrants both peak refining and producing volumes for the time being. However, it is important that the industry guard against over-optimism. There is no indication that it will be desirable to continue production at the high level due in February, and in all probability a reduction in producing rates during March and April would be the best course of action. The recent peak demand is largely the result of cold weather, and therefore is only seasonal. Heating oil requirements, which have climbed sharply, will taper off in March and drop substantially in April as the weather becomes warmer.

If the industry should continue producing at the February peak in March and April, stocks could become excessive. On the other hand, by curtailing output in March and April, the industry can make sure inventories do not become excessive. It would then be far enough into the motor fuel consuming season to have a better idea of future requirements, and can schedule summer production volumes according to indicated needs.

• • •

FACING THE COLDEST WEATHER in three winters, demand for distillate fuel oil in recent weeks soared so sharply refiners found it expedient to boost crude runs to all-time peaks and at the same time adjust upward the amount of crude converted into distillate fuels. Nevertheless, these steps did not prevent an unusually heavy draft on heating oil stocks.

During the five weeks ended January 20 an average of 450,000 barrels of distillate was withdrawn from storage daily. It is customary during this season for distillate stocks to be reduced but not by such large amounts, and these stocks now total but 61¼ million barrels, which is 8¼ million barrels less than in tanks a year ago. With cold weather striking particularly hard at the Midwest and Northeastern U. S., particularly significant changes occurred in inventories east of California. Whereas these stocks in mid-December had been only 2 million barrels under year-ago levels, by mid-January they had been reduced to 5 million barrels under volumes stored last year.

These withdrawal rates become especially noteworthy in view of the enlarged output of distillate fuel during the same period. Crude runs to stills advanced to 6,400,000 barrels per day during the first half of January, over ½ million barrels above the peak which had been reached in December. Higher crude runs coupled with increased distillate yields, resulted in the making of approximately 1,400,000 barrels of distillate fuel daily during the first two weeks of January as compared with only 1 million barrels manufactured per day in January of 1950.

• • •

THE NEED FOR MORE CRUDE was indicated by the impact of higher refinery runs, which caused 55,500 barrels of crude to be taken from storage daily during the four weeks ended January 13. This prompted the Texas Railroad Commission to order an unusual middle-of-the-month increase in the state's oil production allowable, and to continue this increase through February.

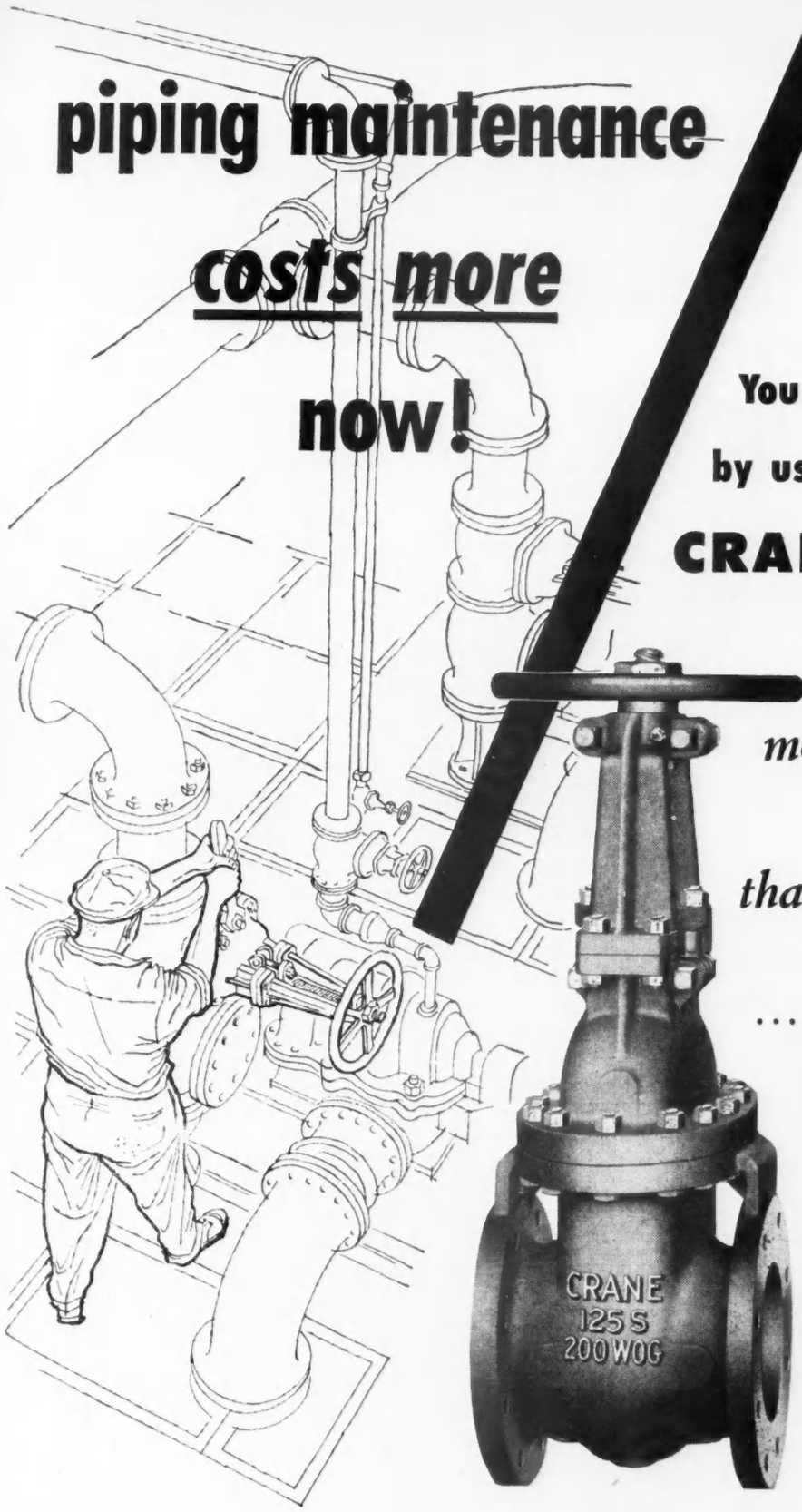
This action indicates that U. S. production in February will reach 5,935,000 barrels daily for the first time in history, or approximately 185,000 barrels per day above December rates.

What influence this increase in production will have on crude stocks depends on the amount of crude run by refiners, which in turn will be determined by the influence of weather on heating oil consumption. However, some addition to crude stocks seem likely in February unless extremely cold weather continues.

• • •

GASOLINE STOCKS were showing the usual seasonal increase, but despite the high refining level were not gaining at alarming rates. During the five weeks ended January 20, gasoline inventories climbed 12¾ million barrels, 365,000 barrels per day. This was slightly under the rate of increase experienced during the corresponding period of the preceding year, as the 123¾ million barrels in storage January 20 was 1½ million barrels more than a year ago and had been 2½ million greater than in the previous year on December 16.

piping maintenance costs more now!



You do less of it

by using Dependable Quality

CRANE VALVES

That's why more Crane Valves are used than any other make

. . . no bonnet trouble with this valve

A typical example of low-maintenance Crane Quality—No. 465½ 125-Pound Iron Body Gates. Rarely does the bonnet joint need attention. Flange construction includes reinforcement to prevent distortion and utilizes more bolts, more closely spaced than is usual in valves of this class. Crane precision-guided seating reduces seat and disc wear. Packing has long life because these valves have a deep stuffing box filled with high grade asbestos ring packing. A ball-type gland equalizes the packing load.

Better performance features like these make Crane the better buy in valves of every type. Ask your Crane Representative for a demonstration.

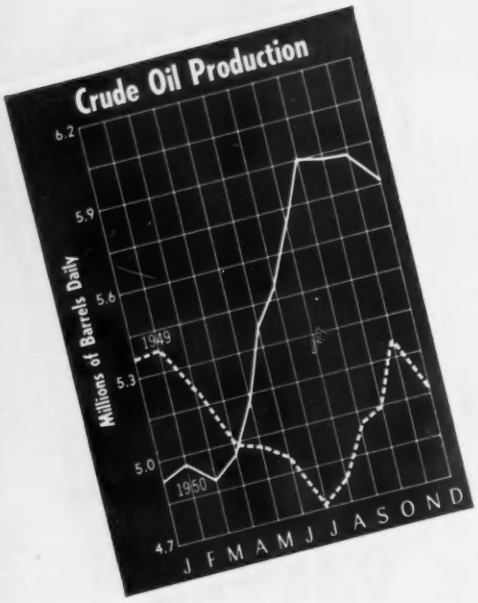
CRANE

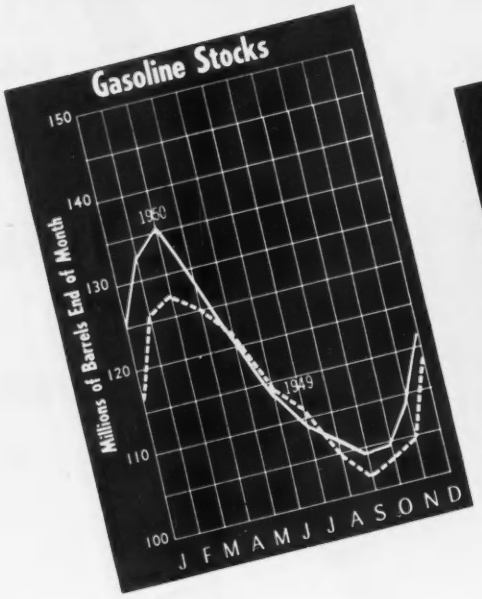
CRANE CO., *General Offices:*
836 S. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas

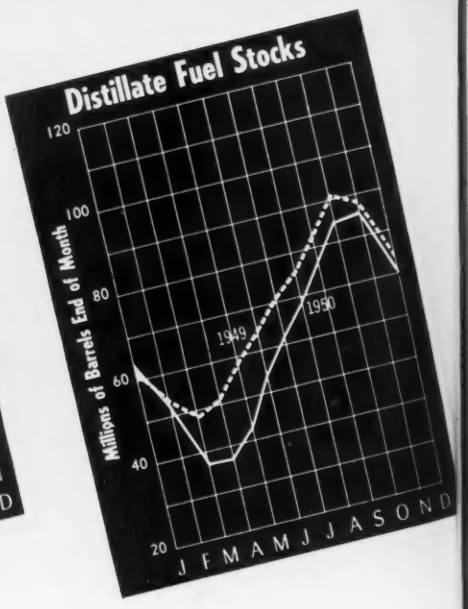
VALVES • FITTINGS • PIPE • PLUMBING • HEATING

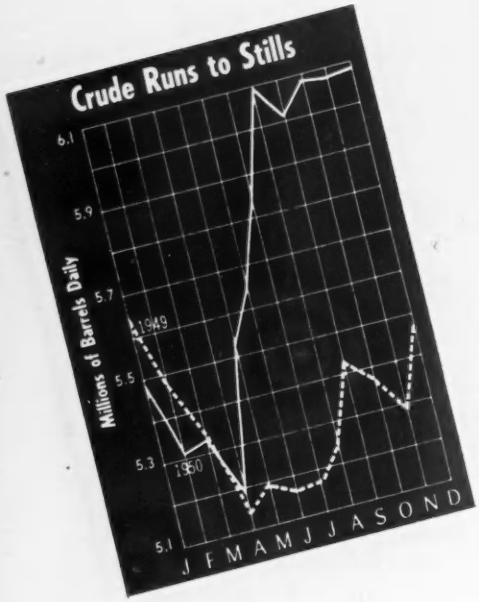
Petroleum T

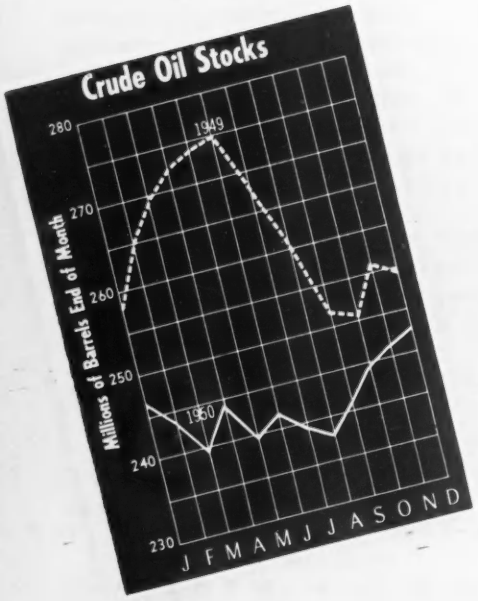
By CECIL W. SMITH
Statistical Editor









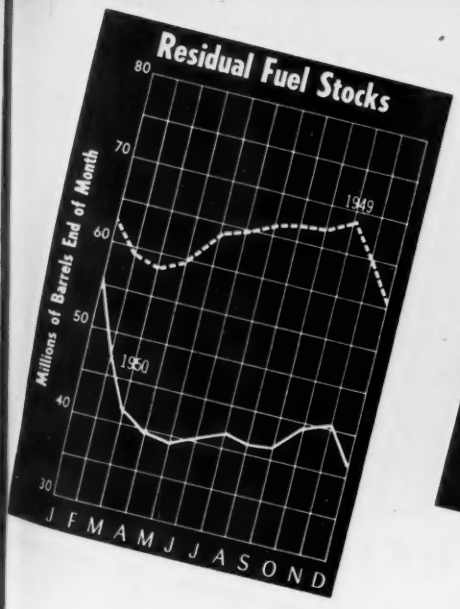


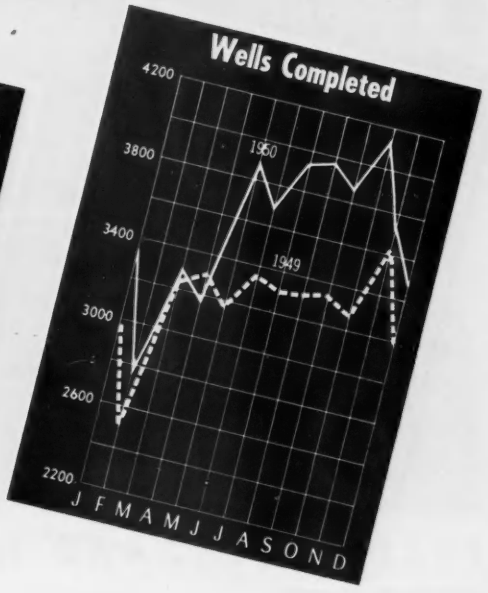
State Crude Oil Production

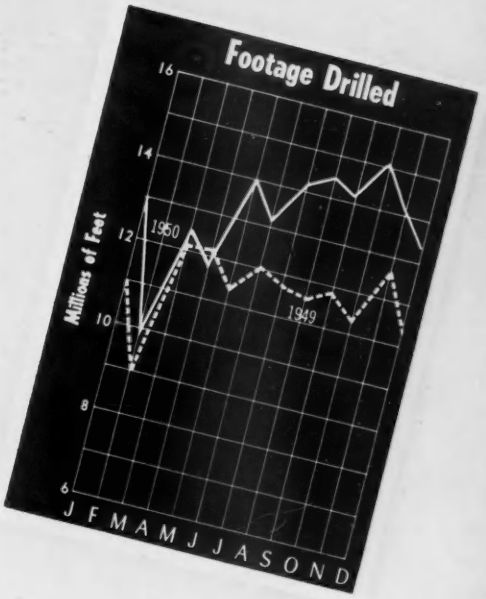
(THOUSANDS OF BARRELS)

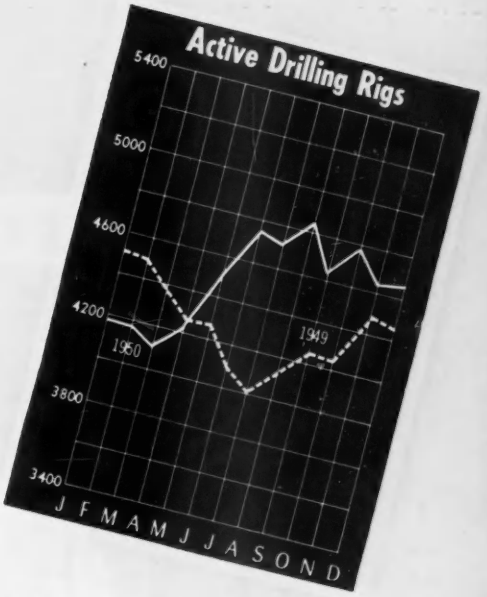
STATE or DISTRICT	Daily Average Production				Total Year		
	Dec., 1950	Nov., 1950	Dec., 1949	% Diff. Dec., '49-'50	1950	1949	% Diff. '49-'50
Alabama	2.7	2.4	1.6	+ 68.8	728	462	+ 57.6
Arkansas	86.1	85.8	85.1	+ 1.2	31,293	29,936	+ 4.5
California	962.1	957.7	868.4	+ 10.8	327,750	332,839	— 1.5
Colorado	78.0	76.7	62.2	+ 25.4	23,499	23,910	— 1.7
Florida	1.5	1.7	0.9	+ 66.7	488	441	+ 10.7
Illinois	171.1	174.5	176.8	— 3.2	62,447	64,583	— 3.3
Indiana	30.5	30.0	28.8	+ 5.9	10,154	9,556	+ 6.3
Kansas	310.8	303.9	279.6	+ 11.2	107,851	101,868	+ 5.9
Kentucky	30.8	29.7	25.2	+ 22.2	10,348	8,656	+ 19.5
Louisiana	616.3	607.4	550.7	+ 11.9	209,247	190,715	+ 9.7
North Louisiana	125.7	125.2	120.0	+ 4.8	44,558	44,393	+ 0.4
South Louisiana	490.6	482.2	430.7	+ 13.9	164,689	146,322	+ 12.6
Michigan	41.8	42.7	47.4	— 11.8	15,930	16,495	— 3.4
Mississippi	106.5	107.8	98.4	+ 8.2	38,330	37,966	+ 1.0
Missouri	0.1	0.1	0.1	.....	29	46	— 37.0
Montana	24.1	23.3	22.7	+ 6.2	8,139	9,149	— 11.1
Nebraska	5.9	5.3	1.6	+268.8	1,423	330	+331.2
New Mexico	129.4	129.5	130.7	— 1.0	47,675	47,932	— 0.5
New York	13.9	14.0	11.3	+ 23.0	4,322	4,248	+ 1.7
Ohio	7.9	8.3	9.0	— 12.2	3,350	3,433	— 2.4
Oklahoma	496.0	492.6	426.5	+ 16.3	164,722	151,902	+ 8.4
Pennsylvania	29.2	30.3	29.6	— 1.4	11,710	11,374	+ 3.0
Tennessee	0.1	0.1	0.1	.....	21	22	— 4.6
Texas	2,423.1	2,577.5	2,019.8	+ 20.0	829,287	743,990	+ 11.5
Dist. 1 South Central	31.1	31.2	26.1	+ 19.2	10,456	9,693	+ 7.9
Dist. 2 Middle Gulf	144.5	151.1	119.5	+ 20.9	49,019	47,559	+ 3.1
Dist. 3 Upper Gulf	446.7	463.0	387.1	+ 15.4	151,780	145,208	+ 4.5
Dist. 4 L. Gulf-S.W.	222.1	232.4	189.5	+ 17.2	76,819	71,987	+ 6.7
Dist. 5 East Central	40.5	43.0	34.3	+ 18.1	13,202	13,562	— 2.7
Dist. 6 Northeast	367.2	392.5	326.2	+ 12.6	131,791	127,680	+ 3.2
Dist. 7-B N. Central	72.7	72.4	61.5	+ 18.2	25,273	22,152	+ 14.1
Dist. 7-C W. Central	80.3	79.3	51.3	+ 56.5	23,273	17,175	+ 35.5
Dist. 8 West	778.6	872.6	586.2	+ 32.8	265,504	210,669	+ 26.0
Dist. 9 North	149.3	150.0	140.7	+ 6.1	52,767	49,392	+ 6.8
Dist. 10 Panhandle	90.0	90.0	92.4	— 2.6	33,153	33,255	— 0.3
Utah	3.5	3.2	3.2	+ 9.4	1,192	637	+ 87.1
Virginia	0.1	0.1	0.1	.....	21	43	— 51.2
West Virginia	7.0	6.6	7.8	— 10.3	2,798	2,839	— 1.5
Wyoming	179.4	171.4	136.7	+ 31.2	60,058	46,935	+ 28.0
Total U. S.	5,757.8	5,882.6	5,024.3	+ 14.6	1,972,812	1,840,307	+ 7.2

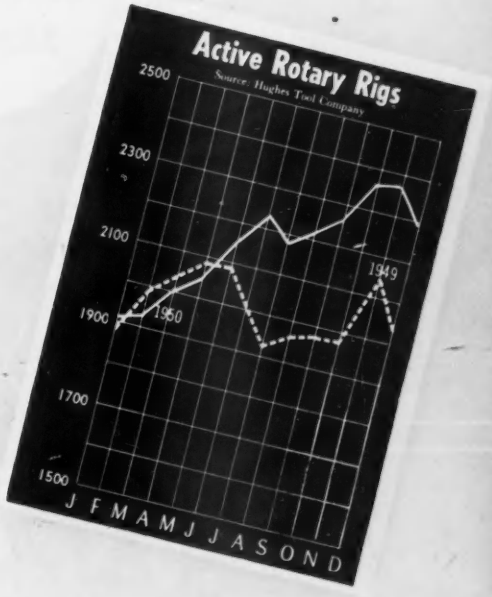
Trends in the U.S.









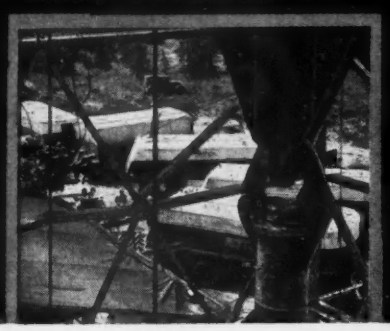


Crude Oil and Refined Products Trends

(THOUSANDS OF BARRELS)

MONTH	CRUDE OIL			GASOLINE		DISTILLATE FUEL		RESIDUAL FUEL	
	Production Daily	Runs to Stills Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month	Production Daily	Stocks End of Month
1948:									
September..	5,435	5,376	237,302	2,416	90,518	961	73,854	1,154	58,982
October....	5,632	5,594	243,972	2,490	92,426	1,069	79,992	1,268	61,456
November..	5,675	5,672	250,066	2,551	95,589	1,081	80,658	1,277	64,865
December..	5,688	5,720	256,254	2,626	103,697	1,106	71,475	1,299	64,021
1949:									
January....	5,265	5,641	258,648	2,538	116,621	1,063	61,584	1,348	62,508
February..	5,376	5,480	265,216	2,484	126,054	1,004	53,937	1,282	59,398
March.....	5,224	5,352	269,341	2,470	127,443	993	48,923	1,258	58,190
April.....	5,012	5,141	272,520	2,494	125,351	846	51,231	1,147	59,668
May.....	4,972	5,195	273,912	2,585	121,602	813	57,442	1,138	63,576
June.....	4,903	5,162	274,691	2,597	114,041	771	64,730	1,041	64,628
July.....	4,704	5,173	267,586	2,613	111,217	835	71,553	1,040	66,084
August.....	4,780	5,241	260,585	2,593	104,879	902	76,037	1,078	66,843
September..	4,940	5,427	251,689	2,617	101,799	1,002	83,213	1,110	67,117
October	4,997	5,373	250,932	2,643	103,287	1,001	90,643	1,141	68,673
November..	5,210	5,293	256,010	2,594	104,707	962	88,212	1,180	65,112
December..	5,024	5,475	253,356	2,633	111,521	1,032	75,207	1,203	60,193
1950:									
January....	4,922	5,483	246,610	2,575	125,298	1,048	63,932	1,209	55,808
February...	4,967	5,316	243,750	2,552	132,796	1,026	52,206	1,172	47,828
March.....	4,878	5,336	241,098	2,539	133,766	938	37,777	1,154	41,860
April.....	4,968	5,193	244,605	2,508	128,057	977	37,530	1,048	39,979
May.....	5,143	5,535	239,877	2,647	121,035	997	42,739	1,063	39,482
June.....	5,378	5,655	242,287	2,748	114,074	1,037	53,679	1,969	40,124
July.....	5,484	5,882	240,270	2,835	111,055	1,040	62,555	1,140	42,165
August.....	5,665	6,067	237,393	2,932	107,067	1,089	68,426	1,148	40,979
September..	5,888	6,059	242,311	2,849	105,748	1,180	78,270	1,178	41,966
October....	5,900	6,077	246,424	2,875	105,764	1,217	85,643	1,250	44,586
November..	5,883	6,081	246,818	2,825	108,628	1,215	85,427	1,225	45,320
December..	5,758	6,092	247,814	2,872	117,220	1,307	70,872	1,280	41,184
Dec., 1950 Change:									
In Month...	—125	+11	+996	+47	+8,592	+92	—14,555	+55	—4,136
In Year....	+734	+617	—5,542	+239	+5,699	+275	—4,335	+77	—19,009
Week Ended:									
Jan. 13, 1951..	5,762	6,370	245,719	2,974	121,209	1,437	64,557	1,398	41,675
Jan. 14, 1950..	4,925	5,487	249,867	2,632	118,844	1,085	71,075	1,151	60,003

HOWCO EXPERIENCE ★ HOWCO SERVICE ★ HOWCO TOOLS RESEARCH EQUIPMENT



IT TAKES MORE THAN CEMENT AND WATER!

HOWCO
CEMENTING SERVICES

HOWCO RESEARCH NEVER STOPS! That's why so many difficult problems in oil well cementing get their first *right* answers from HOWCO . . . that's why so many advancements in cementing tool design and sound, successful cementing methods come from HOWCO . . . that's why HOWCO leads in oil well cementing . . . and that's why *you* should consult your nearby HOWCO representative about *your* cementing problems. Call him today!

THERE'S NO SUBSTITUTE FOR EXPERIENCE IN OIL WELL CEMENTING!

HALLIBURTON OIL WELL CEMENTING CO. DUNCAN, OKLAHOMA.

Monthly News Analysis

States Consider Truce On Tidelands Argument

Growling and bristling like a pair of dogs not through fighting over a juicy bone, the states and federal government were warily sniffing at a temporary tidelands truce last month.

When the Santa Clauses of the Supreme Court handed the tidelands to the federal government, Interior Department Secretary Oscar Chapman found himself in the same fix as a fellow who has been given an automobile but has neither the know-how nor the license to drive it. His authority in this case is limited to the prevention of waste of federal property, and since nobody seemed to be wasting anything, he began looking to interim legislation that would give him management over the tidelands while Congress makes up its mind whether to set up some laws to administer the submerged lands or to override President Truman and return them to the states.

The interim legislation was introduced by Senators O'Mahoney (D., Wyo.) and Anderson (D., N. M.) and would:

- Give the states 37½ percent of all revenue within the three-mile limit and hold in escrow for the federal government the other 62½ percent until permanent legislation is passed. (Senator O'Mahoney indicated this may be extended to 10½ miles in Texas' case.)
- Give the federal government, in escrow, all revenue beyond the three-mile limit (or 10½-mile limit for Texas).
- Recognize leases previously granted by the states. Chapman would be authorized to do leasing in the future.

First reaction of states and the oil companies indicated cautious approval of most points in the bill as "a step in the right direction," but they wanted it understood that this is a truce, not a surrender.

Texans found cause for jubilation in O'Mahoney's statement that "Texas has a good claim to a traditional boundary 10½ miles from shore." However, he didn't go out far enough, in the opinion of Price Daniel, Texas Attorney General. "One of the main things we are fighting for is restoration of ownership to the 10½-mile limit and a share, 37½ percent if possible, of the revenue beyond that limit." (By "beyond that limit" he meant to the continental shelf—100-fathom line—which is 140 miles offshore along the Southeast Texas shoreline and about 70 in the Brownsville vicinity.)

Oil Field Equipment Put Under PAD Jurisdiction

Full authority over the production and distribution of oil field equipment was vested in Petroleum Administration for Defense last month after a horse-trading session with the National Production Authority.

The new agreement was signed by PAD's Bruce K. Brown and NPA's W. H. Harrison and is intended to remain substantially intact after creation of the new Defense Production Administration which, as the top level mobilization agency, will redelegate functions now held by PAD and NPA.

In addition to being made responsible for "production and distribution of machinery and equipment required for the discovery, development or depletion of oil or gas wells," PAD was given authority previously vested in NPA, over production and distribution of such industrial chemicals as tetraethyl lead, catalysts, gasoline inhibitors and lube oil additives.

PAD retained authority over production of a wide range of oil-derivative chemicals, but surrendered to NPA the responsibility for their distribution.

NPA took from PAD the authority over the production and distribution of oil-derivative products such as carbon black, ammonia and butyl.

Under the provision dealing with oil field equipment, PAD will act generally as an oil industry division of NPA in much the same manner as NPA's steel division now functions. Future directives on products involved in the swap will be issued by NPA, though those in PAD's bailiwick will be acted upon only upon the latter's recommendation.

An early task for PAD will be to determine how much steel and other basic materials are needed by manufacturers of oil field equipment. This was to be discussed in Washington January 31 at a meeting of manufacturers. Estimates would then be turned over to NPA, which will channel the required basic materials to the manufacturers and get the oil field supplies fabricated.

Order Your Copy of 1950 World Oil Index

The complete editorial index covering all issues of WORLD OIL published during 1950 has been prepared and is bound separately in convenient pamphlet form. It will be sent free to all subscribers who write requesting copies.

Orders should be addressed immediately to the Circulation Department, Box 2608, Houston 1, Texas, as quantities are limited.

Industry Promised Enough Steel for 44,000 Wells

Another PAD-NPA deal promised the allocation of enough steel to let oil companies drill 44,000 new wells in 1951.

It was estimated that 1,890,000 tons would be needed. Last year, 1,700,000 tons of tubular steel were used to drill approximately 42,000 wells.

Brown disclosed that PAD was developing a plan to assure effective utilization of the steel "so that we'll get not just 44,000 wells this year but 50,000."

In Austin, Ernest O. Thompson, senior member of the Texas Railroad Commission, pronounced the plans adequate. "With broader spacing, it ought to get the job done." He said he was especially happy over proposed arrangements under which steel mills will set aside 5 percent of their output for drilling wildcat and offset wells.

Truman on Schedule With Rap at Depletion Clause

Like a cracked phonograph record that plays each January, Harry Truman came up on schedule with his outburst on percentage depletion.

On January 23, 1950, the President

called percentage depletion "a shocking example of how present tax loopholes permit a few to gain enormous wealth without paying their fair share of taxes."

On January 11, 1951, Mr. Truman transmitted to the Congress a review of his Council of Economic Advisors who held that ". . . percentage depletion treatment is so excessive for some industries as to constitute a major inequity . . ." No names were named, but oil's 27½ percent allowance is the largest permitted any industry, and just to make it a little plainer whose toes he was stomping, the President added a phrase that sounded mighty like that "loophole" speech of a year ago. Said he: "Many loopholes in the tax laws should be closed."

The President's attack on percentage depletion came to nothing last year, just as it had every year since 1942, when Morgenthau charged that the government was losing $80 million a year in revenue because of "special privileges extended to the oil and gas industries."

But this year the scenes have been shifted, and it might not turn out to be the same old act, with percentage depletion triumphing at the end.

Best reason for cutting the depletion allowance that Mr. Truman could think of last year was that it would permit a reduction in wartime excise taxes. That wasn't enough to convince the solid bloc of Congressmen from the minerals states.

But this year we are at war, which can bring words like "patriotism" and "sacrifice" into the President's argument. Moreover, he has estimated that the government must raise an additional $19 2 billion to meet expenditures in 1951 and 1952 of $118.8 billion.

From what new sources can the President hope to get that much money?

The oil industry wished it didn't know.

High Court Sides With Oil Firm in Price Case

The Supreme Court has ruled that it's not against the law to scramble for a buck.

Specifically, it made price competition legal—in certain cases—by overruling a lower court ruling in the Detroit case involving Standard Oil Company (Ind.).

The Detroit case originated when the Federal Trade Commission brought price discrimination charges against Indiana Standard, contending that in 1940 the company sold gasoline to four jobbers in the Detroit area at lower prices than it was selling to other outlets.

Indiana Standard contended that it sold at lower prices to the four jobbers than it did to other buyers in order to retain them as customers, and to meet the equally low price of a competitor.

FTC issued a cease-and-desist order, holding that such reduced prices injured competition. The company appealed to the Circuit Court of Appeals, which ruled in favor of FTC, declaring that its price-cutting "was used to affect and lessen competition at the retail level."

When it came its turn, the Supreme Court concluded that "Congress meant to permit the natural consequences to follow the seller's action in meeting in good faith a lawful and equally low price of its competitor."

However, the High Court did not throw open the door to free enterprise as this country once knew it. There are beartraps in those green pastures. For instance, if A cuts prices to meet the prices of B, and it later turns out that B's prices are "discriminatory," then A has violated the law, too.

Moreover, the High Court didn't mean it will condone the UNDERCUTTING of prices. Best play safe by having a customer produce the rival's written price quotations.

Price Freeze at Jan. 1 Levels Wouldn't Cripple

Because crude and refined products prices have been stable since mid-December, a mandatory price freeze on all commodities at January 1 levels would result in little change in oil prices.

(Quick action on the mandatory freeze was seen in the resignation of Alan Valentine as Economic Stabilizer and the appointment of Eric Johnston, president of Motion Pictures Association of America, as his successor.

(Valentine's go-slow policy on mandatory price-wage controls had precipitated a break with Price Stabilizer Michael V. DiSalle, who had urged immediate action. DiSalle won—and stays.)

ESA had been considering a rollback on California crude prices to October 22, the date just prior to a 25-cent price boost by California refiners. PAD warned that a California price rollback would have a disastrous effect on oil production for defense needs, and apparently the advice was heeded.

The feeling in California is that even with the latest 25-cent increase in posted price for heavier crudes (initiated by Union Oil Company of California October 23 and followed by Standard Oil Company of California December 12), the current postings still are some 50 cents per barrel below the peak price reached by this grade crude in 1948.

Pressure for products price rollback were lessened by the Bureau of Mines report that fuel oil supplies are ample for the present heating season. The demand can be met, said the Bureau "by a further readjustment in yields between products or a moderate increase in the amount of crude oil refined." The Bureau forecast January crude demand at 5,715,000 barrels daily, slightly higher than for December.

Scramble Slated Among U. S. Importing Firms

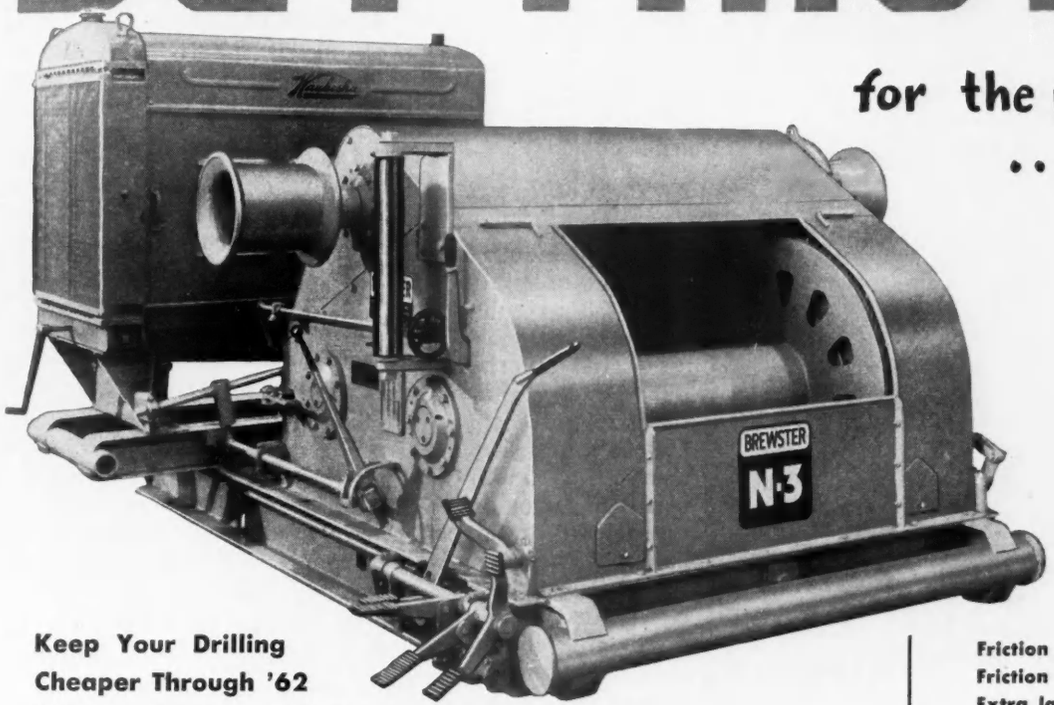
Oil importing companies are expected to scramble to bring into the U. S. as much crude and fuel oil as will be legally possible at the 10½ cents a barrel tariff, but only about one third of all oil imported in 1951 will be admitted in that duty bracket, it is predicted. More than half of the imports will carry the new 21 cents a barrel impost, while the rest will be duty-free as government purchases or for bunkering use.

With the end of the Mexican trade agreement on December 31, 1950, the terms of the earlier Venezuelan agreement again came into effect, covering not only crude but topped crude, gas oil and fuel oil. Until this year all taxable imports of oil were at the rate of 10½ cents a barrel. The new arrangement carries a stepup provision so that only an amount equal to 5 percent of crude refinery runs in the U. S. during the preceding year will be admitted at the 10½-cent rate. On all in excess of that amount, the tariff will be 21 cents a barrel.

A proclamation decree by the White House has established percentage quotas by countries. The quota for the 10½ cents a barrel imports are as follows: Venezuela, 59.4 percent; Netherlands, 18.7 percent; other foreign countries, 21.9 percent. The State Department estimated that the 1951 quotas for the low-duty oil will admit more than 100 million barrels into the U. S. However, since these quotas are not on a monthly basis, but first-come-first-served, an importing race is considered probable.

BUY THIS RIG NOW

for the next 11 years ....and more!



LET THESE FEATURES
SEE YOU THROUGH
'TIL '62—AND LONGER

Keep Your Drilling Cheaper Through '62 With the Brewster N-3 Drawworks.

Let the N-3 save you money for the next 11 years—and more—just as its first model has been turning in cheaper drilling day after day for the past 11 years.

Buy the rig that is making money for contractors in every field where there is shallow drilling.

There's 41 years experience built into the Brewster N-3—Experience of contractors and drillers—Experience of Brewster engineers and craftsmen.

WRITE TODAY for the new pocket size Brewster catalog. It gives you complete information on the N-3 and other Brewster drilling equipment.

- Friction clutches on drum
- Friction clutches on rotary drive
- Extra large brakes
- Extra large drum shaft
- Floating Drum assembly
- Positive block clutch to by-pass friction clutch on drum

N-3 MATCHED EQUIPMENT

H-50 HOOK BLOCK

3S OILBATH SWIVEL

OB - 12 - L ROTARY

SUPPLY HOUSES

APEX EQUIPMENT COMPANY
BOVAIRD SUPPLY COMPANY
REAMS SUPPLY COMPANY
INDUSTRIAL SUPPLY COMPANY
MURRAY BROOKS, INC.
In Canada at:
ROCKY MOUNTAIN SUPPLY COMPANY

24 HOUR SERVICE

BREWSTER DRILLING EQUIPMENT

THE BREWSTER COMPANY, INC.

SHREVEPORT, LOUISIANA

Since 1910 Manufacturers of fine Drilling Equipment

Survey Would Determine Which Lines to Construct

Petroleum Administration for Defense has begun a survey to determine what gas and oil pipe lines should be built under conditions of steel shortage. While pipe line construction programs are approved by the Federal Power Commission, PAD serves as claimant agency for steel for the petroleum industry and hence allocations of steel for pipe would hinge largely on PAD recommendations. PAD also recommends loans and accelerated depreciation for defense facilities.

The study will ascertain what pipe lines are essential for the domestic economy and national defense. Many industry economists predict that a curtailment may be expected in the rapid expansion of gas pipe lines which in the last year have been requiring more tubular goods than the oil pipe lines. However, no policy has been defined yet. But apparently in anticipation of such restriction. Texas Gas Transmission Corporation moved quickly to avert a cutback in Illinois and Ohio. In application filed with the FPC, the $100 million gas system asks approval to build 580 miles of 26-inch line to transport 200 million cubic feet of gas into these two states and to priority consumers elsewhere in the Midwest.

Tanker Pool Program May Bring New Rate Schedule

The government's new "tanker pool" program may result in a rate schedule supplanting the former and now outdated USMC tariff. Under the pool tanker operators would make space available to the Defense Department at the request of the Maritime Administrator. When any company supplied such space, it would be credited with the amount provided in the carriers of other operators. The plan was revealed by Commerce and Interior Departments, after a consultation with operators, to allow the armed services to make use of ships closest to their oil supply. The pool would be managed by a Tanker Requirements Committee for the petroleum industry.

The provision covering charter rates reads: "Charters of vessels made at the request of the Maritime Administration, pursuant to the plan, shall be made at a fair and equitable rate to be determined by the Administrator after consultation with the committee and the Department of Defense, and such rate shall govern in all transactions among the participants in the plan insofar as operations under the plan are concerned."

Each member of the pool would agree to contribute tonnage capacity "in proportion that its controlled tonnage bears to the total controlled tonnage." "Controlled tonnage" means total carrying capacity, expressed in terms of 30-degree gravity crude oil, Port Arthur/New York, of all tankers over 6000 deadweight tons capacity which are (a) owned by the participant under U. S. flag registry, plus (b) on charter to such participant for a period of six months or more from the date of the plan, regardless of the flag of registry, less (c) chartered out to others for a period of six months or more from the date of the plan.

The program was devised by industry representatives under Dene Hodges of Shell Oil Company, who is director of the supply-transportation division of Petroleum Administration for Defense.

Be Prepared, Industry Urged

A mechanical error caused omission of a part of K. S. Adams' message in a January WORLD OIL feature, "What's Ahead in '51?" Because of its importance, the entire message is being reproduced.

K. S. Adams, President

Phillips Petroleum Company

In looking forward to 1951, one problem appears more serious than all others. How can the oil industry most effectively utilize all its abilities to be of greatest value in the present international situation? Oil is a fundamental and indispensable factor in the defense of this nation. Therefore, the oil industry can be regarded as fully discharging its responsibilities only if it conceives and effectively carries out a program which will make its maximum potentialities available when and if called upon.

K. S. Adams

This country has come to rely more and more on petroleum produced in foreign countries. Some of this oil, like that in the Middle East, cannot be depended upon in event of any major international incident in that area. Naturally, all of us fervently hope that no military occasion will arise to call for a flood of oil as great or perhaps much greater than that which our industry had to produce in World War II. However, we cannot safely base our plans on hopes alone. We must face the stark realities and be prepared to supply all military and civilian petroleum products from this hemisphere and in whatever quantities any occasion might demand.

It is becoming increasingly difficult for the oil industry to operate in the face of many increases in the costs of finding, developing, and producing crude oil and natural gas. Recent wage hikes and increases in the cost of steel and most other materials are increasingly serious barriers to the building up of adequate reserves. Steel is most difficult to obtain. The supply of manpower is gradually decreasing.

Also, there are the very important factors of higher taxes, new governmental restrictions and regulations, and perhaps most complicating of all, the constant threat of anti-trust suits and similar governmental attacks. Hearings of various kinds require an unbelievable number of man-hours of key personnel, which could be better used at this time.

In the principal producing areas of the U. S. the price received for crude oil has remained constant, with minor exceptions, for more than three years. This has been a long period of successively rising operating costs. Every increase in costs has diminished the incentive and ability to find, develop, and produce new crude oil reserves. The present static crude oil selling price could well become one of the greatest stumbling blocks in our nation's military preparedness program. It is absolutely necessary that we immediately start to develop in North and South America reserves of oil and gas adequate to supply ourselves and our potential allies.

Operators say it's TRUE!

When experienced operators say "Lane-Wells does a dash-blank good perforating job," there's an opinion worth listening to. And experienced operators in every field — veterans and smart younger men — do say just about that.

Some of these canny old-timers have been using Lane-Wells services for nearly 18 years; according to them, there's no substitute for experience. Lots of younger operators, too, find that the experience gained in over 143,000 perforating jobs helps a lot on their jobs — so they use Lane-Wells perforating.

Not all operators feel that way. We never claimed to bat 1.000 all the time Even Ivory soap says only, '99-44/100% pure': perfection costs *more* than anyone can afford. But Lane-Wells batting average is, and always has been, in the high 900's. And lots of operators like Lane-Wells service because we don't alibi if something does go wrong, because we do our best to make it good. Ask your Lane-Wells man about

by LANE WELLS

TECHNICAL OIL FIELD SERVICES

General Offices, Export Office and Plant • 5610 So. Soto St. Los Angeles 58, California

Los Angeles • Houston • Oklahoma City
Lane-Wells Canadian Co. in Canada
Petro-Tech Service Co. in Venezuela

1950 Completions

Hit Record 43,939

THE final count on the number of wells drilled during 1950 showed that the industry's drillers had the busiest year in history. They not only exceeded the previous high reached in 1948 when practically all the industry's operations were at peaks, but they topped it by almost 4000 wells.

The task of drilling last year's wells was more an accomplishment than is indicated by the mere statement of the number of wells completed. A more accurate measure of the year's activity is obtained by considering the amount of footage drilled in those wells.

The previous all-time record amount of footage drilled in a single year was recorded in 1949, when 139,062,620 feet were drilled. But, the unprecedented drilling rates of 1950 accounted for 159,977,580 feet and that topped the old record by more than 20 million feet and 15 percent.

Total wells completed during 1950 amounted to 43,939, while the previous high mark had been 40,010 drilled two years before. In the number of wells drilled, the past year's was 9.8 percent greater than had ever before been completed, but total footage penetrated topped its previous high by 15 percent.

Each new well in 1950 was drilled to 3689 feet on the average, while those of 1949 were carried to only 3558 feet, and that too was a new all-time record.

A number of areas were the scenes of increased drilling during the year, but the principal rise was recorded in Texas. In that state there were 2967 more wells and 14,567,510 more feet drilled than in the year before. The next greatest gain occurred in Oklahoma where 952 more wells and 3,446,556 feet were drilled. Kansas recorded almost as great an increase as Oklahoma by stepping up its activity by 921 wells and 2,747,781 feet during 1950.

Well Completions in the United States During December, 1950, and Cumulative for Year

(Figures compiled by WORLD OIL Staff from private reports and other sources as follows: Illinois from Illinois Geological Survey: Indiana from Indiana Division of Geology; Missouri from Missouri Geological Survey: Tennessee from Tennessee Division of Geology; Bradford, Kane-Clarendon and Allegany fields of Pennsylvania and New York from the "Producers Monthly.")

STATE or DISTRICT	MONTHLY COMPLETIONS, DECEMBER, 1950													CUMULATIVE TOTALS January-December					Rigs in Operation (Drilling, Rigging Up and Shut Down)		
	NEW WELLS								TOTAL COMPLETIONS												
	Oil	Dist.	Gas	Dry	Water Input	Gas Input	Water Disposal	Total New	Total Drilled Deeper	Dec., 1950	Nov., 1950	Dec., 1949	Footage Dec., 1950	Wells 1950	Wells 1949	Percent Diff.	Footage 1950	Footage 1949	Dec. 31, 1950	Nov. 30, 1950	Dec. 31, 1949
Alabama	2			3				5		5	4	4	22,231	46	19	+142.1	198,788	88,654	8	8	2
Arizona											3			8	5	+ 60.0	32,108	15,603	3	3	3
Arkansas	24	1	2	14				41		41	38	31	141,674	399	336	+ 18.8	1,329,236	1,303,935	30	37	25
California	131		4	36				171	4	175	204	150	709,276	1,922	2,485	— 22.7	7,748,767	9,919,185	207	192	206
Colorado	5		2	9				16		16	9	8	80,409	92	70	+ 31.4	393,734	305,355	25	25	14
Florida												1		11	18	— 38.9	69,518	125,743	1	1	4
Georgia														3	4	— 25.0	13,270	12,437			1
Idaho											1			5			16,367		1	1	
Illinois	110		4	157				271		271	246	299	694,862	2,911	2,721	+ 7.0	6,358,395	6,355,023	246	250	234
Indiana	36		1	58				95		95	154	129	175,663	1,581	1,254	+ 26.1	2,726,447	2,310,403	217	194	138
Kansas	199		41	163	1		1	405		405	296	242	1,318,408	4,003	3,082	+ 29.9	12,912,421	10,164,640	337	333	302
Kentucky	36		19	44				99		99	110	74	292,100	1,249	1,107	+ 12.8	2,332,871	1,921,177	104	110	86
Louisiana	90	14	19	76	1			200	2	202	198	244	1,229,303	2,464	2,342	+ 5.2	14,815,786	12,504,218	235	252	236
North Louisiana	46	6	13	45				110		110	112	164	431,639	1,318	1,434	— 8.1	4,680,816	4,654,779	78	88	75
South Louisiana	44	8	6	31	1			90	2	92	86	80	797,664	1,146	908	+ 26.2	10,134,970	7,849,439	157	164	161
Maryland														4	1	+300.0	16,636	4,910	8	5	
Michigan	18		3	28				49		49	85	51	139,295	834	902	— 7.5	2,055,240	2,068,339	120	116	135
Mississippi	8	3		10				21	2	23	18	26	163,912	325	337	— 3.6	2,334,451	2,454,663	27	27	34
Missouri											1	6		27	32	— 15.6	21,482	17,078	6	6	7
Montana	9		1	4				14		14	28	7	34,286	269	251	+ 7.2	667,933	626,520	34	37	35
Nebraska	4		2	4				10		10	8	1	53,690	108	15	+620.0	464,141	64,272	9	10	7
Nevada											2			2			14,439		1		
New Mexico	32		3	4				39	2	41	51	37	162,868	613	517	+ 18.6	2,697,902	2,254,904	108	87	95
New York	21				15			36		36	43	80	59,232	723	915	— 21.0	1,056,985	1,306,960	75	92	105
North Carolina															1	—100.0		1,280			
North Dakota				3				3		3		1	27,062	3	5	— 40.0	27,062	26,465	2	2	
Ohio	20		23	24				67	1	68	85	80	155,084	992	1,048	— 5.3	2,052,948	2,207,198	140	156	152
Oklahoma	219	4	12	109	9			353	6	359	468	345	1,455,310	5,363	4,411	+ 21.6	19,071,211	15,624,655	682	671	540
Oregon															1	—100.0		6,480	1	1	
Pennsylvania	40		18	5	36	8		107		107	153	124	183,480	1,634	2,075	— 21.3	2,957,175	3,904,040	243	250	245
South Dakota				1				1		1	1		3,143	7	6	+ 16.7	22,540	12,803			2
Tennessee														3	47	— 93.6	3,993	48,591	8	7	7
Texas	829	13	62	465	8	1		1,378	29	1,407	1,549	1,197	6,181,244	17,679	14,112	+ 21.0	72,883,613	58,316,093	1,485	1,469	1,398
Dist. 1 S. Central	12			25	1			38	3	41	69	54	114,185	527	566	— 6.9	1,556,084	1,678,282	35	34	33
Dist. 2 Middle Gulf	21	4	7	19				51		51	61	59	288,833	698	657	+ 6.2	4,014,447	3,839,911	57	50	43
Dist. 3 Upper Gulf	85	5	25	47				162	2	164	121	124	1,046,410	1,604	1,397	+ 14.8	9,583,314	8,310,362	149	144	125
Dist. 4 L. Gulf-S.W.	85	3	3	39				130	3	133	173	114	635,334	1,686	1,345	+ 25.4	8,135,755	6,670,508	110	104	111
Dist. 5 E. Central	9			10				19		19	23	17	78,967	207	196	+ 5.6	919,263	923,918	29	22	21
Dist. 6 Northeast	66	1		16				83		83	78	75	403,124	718	890	— 19.3	3,450,550	3,959,667	50	37	42
Dist. 7-B N. Central	105		3	102				210	3	213	197	143	566,319	2,114	1,902	+ 11.1	5,780,928	5,587,088	144	147	167
Dist. 7-C W. Central	52			28				80	2	82	94	56	333,848	982	511	+ 92.2	3,896,357	2,248,094	109	105	90
Dist. 8 West	238			61	1			300	15	315	424	213	1,780,411	4,276	2,883	+ 48.3	23,118,694	14,252,050	459	484	479
Dist. 9 North	120		3	103	6	1		233	1	234	230	257	705,858	3,209	2,668	+ 20.3	9,106,387	7,312,654	236	239	181
Dist. 10 Panhandle	36		21	15				72		72	79	85	231,855	1,058	1,097	— 3.6	3,321,824	3,533,559	107	103	106
Utah				3				3		3	2	4	3,022	24	57	— 57.9	83,875	283,899	11	10	8
Virginia															16	—100.0		71,098	1	1	1
Washington												1		2	2		16,032	4,910			
West Virginia	3		24	10				37	1	38	47	51	99,100	633	700	— 9.6	1,633,884	1,885,145	205	210	242
Wyoming	34	1		17				52		52	47	43	254,092	600	603	— 0.5	2,948,340	2,846,544	85	86	91
Total U.S.	1,870	36	240	1,247	70	9	1	3,473	47	3,520	3,851	3,227	13,449,746	43,939	39,497	+ 11.2	159,977,580	139,062,620	4,665	4,649	4,355

Light Texas Skies

By L. J. LOGAN, Associate Editor

AMAZING PROGRESS has been made in eliminating venting and other losses of natural gas in Texas during the past five years. This progress undoubtedly constitutes one of the greatest accomplishments in the history of conservation. Despite a very large increase in gas production, the amount burned in flares has been reduced from a substantial volume to a negligible amount. Much of the reduction has been achieved by reducing the venting of gas at processing plants. Conservation and maximum utilization of gas have been made possible by heavy investments of private companies in gas processing plants and pipe line facilities. These investments have provided larger markets and better prices for gas, and the increased market value of the gas in turn has promoted construction of more facilities and more conservation.

WHEN the prolific Conroe field on the Texas Gulf Coast was being developed nearly 20 years ago, one major company that had been skeptical about it and declined to buy leases in the area was kidded with the statement that flares had been lighted so the company's men could find the field.

For the same purpose now, a guide or other help would be needed. For rapidly vanishing are the flares that commonly lighted Texas skies at night in the past, as owners of oil wells and

Table 1
Ultimate Distribution of Gas Produced in Texas Since 1939
(Thousands of Cubic Feet Annually)

	Total Gas Produced	TO PIPE LINES		FOR RECYCLING, PRESSURE MAINTENANCE AND REPRESSURING		TO CARBON BLACK		EXTRACTION LOSS AT GASOLINE PLANTS		FOR PLANT FUEL AND LEASE OPERATIONS		FOR GAS LIFT		VENTED TO AIR AND LINE LOSSES	
		Amount	Percent of Prod.	Amount	Percent of Prod.	Amount	Percent of Prod.	Amount	Percent of Prod.	Amount	Percent of Prod.	Amount	Percent of Prod.	Amount	Percent of Prod.
1939	1,298,307,000	462,072,000	35.6	105,438,000	8.1	316,804,000	24.4	50,891,000	3.9	170,853,000	13.2	49,846,000	3.8	142,403,000	11 0
1940	1,544,089,000	494,826,000	32.1	265,677,000	17.2	326,050,000	21.1	56,210,000	3.6	216,583,000	14.0	52,003,000	3.4	132,740,000	8.6
1941	1,817,150,000	559,279,000	30.8	481,607,000	26.5	329,361,000	18.1	71,667,000	3.9	213,391,000	11.8	60,698,000	3.3	101,147,000	5.6
1942	1,916,825,000	683,473,000	35.6	531,164,000	27.7	295,612,000	15.4	68,692,000	3.6	193,204,000	10.1	62,692,000	3.3	81,988,000	4.3
1943	2,182,065,000	821,511,000	37.7	622,890,000	28.5	274,507,000	12.6	72,175,000	3.3	218,526,000	10.0	81,334,000	3.7	91,121,000	4.2
1944	2,477,699,000	1,022,181,000	41.3	626,708,000	25.3	295,953,000	11.9	80,628,000	3.3	238,035,000	9.6	102,630,000	4.1	111,563,000	4.5
1945	2,665,177,745	1,088,393,000	40.8	645,756,186	24.2	366,942,224	13.8	87,582,987	3.3	261,958,262	9.8	95,496,035	3.6	119,048,103	4.5
1946	2,768,938,826	1,102,603,670	39.8	696,990,242	25.2	404,995,714	14.6	89,464,547	3.3	271,273,930	9.8	95,126,144	3.4	108,484,579	3.9
1947	2,937,500,687	1,236,637,600	42.1	739,704,977	25.2	385,576,043	13.1	93,408,659	3.2	276,268,176	9.4	108,111,559	3.7	97,793,573	3.3
1948	3,299,285,413	1,545,698,225	46.9	757,144,809	22.9	381,466,159	11.6	102,709,010	3.1	288,071,022	8.7	121,773,684	3.7	102,422,509	3.1
1949	3 519,173,751	1,804,852,205	51.3	798,011,434	22.7	330,184,594	9.4	120,244,268	3.4	299,418,016	8.5	124,573,879	3.5	41,909,355	1.2
First Half 1950	1,934,487,412	1,046,058,380	54.1	427,732,208	22.1	147,226,056	7.6	69,252,016	3.6	164,210,473	8.5	66,978,692	3.5	13,029,587	0.6

Table 2.

Ultimate Disposition of All Texas Gas

(Including Processing Plant Residue. Figures in Thousands of Cubic Feet Daily)

	1945	First Half 1950	Percent Change 1945-1950	PERCENT OF TOTAL 1945	1950
Plant Fuel and Lease Operations	717,694	907,240	+ 26.4	9.8	8.5
Gas Lift	261,633	370,048	+ 41.4	3.6	3.5
Pressure Maintenance, Repressuring	354,163	805,896	+127.5	4.8	7.5
Transmission Lines	2,981,901	5,779,328	+ 93.8	40.8	54.1
Recycled	1,415,032	1,557,265	+ 10.1	19.4	14.6
Plant Extraction Losses	239,953	382,608	+ 59.5	3.3	3.6
To Carbon Black Manufacture	1,005,321	813,404	— 19.1	13.8	7.6
Vented and Line Losses, Total	326,159	71,986	— 77.9	4.5	0.6
Casinghead from Wells	11,703	9,996	— 14.6	0.2	0.0
Gas from Gas Wells	2,117	(—) 924	—143.6	0.0	0.0
Gasoline Plant Residue	295,545	57,746	— 80.5	4.1	0.5
Recycling Plant Residue	16,794	5,168	— 69.2	0.2	0.0
Total Production	7,301,856	10,687,775	+ 46.4	100.0	100.0

This table is for both casinghead and gas well gas.

Table 3.

Texas Casinghead Gas Production and Disposition

(Thousands of Cubic Feet Daily)

	1945	First Ha'f 1950	Percent Change 1945-1950	PERCENT OF TOTAL 1945	1950
Fuel System, Lease Use	65,824	84,714	+ 28.7	4.0	3.7
Gas Lift	13,781	21,914	+ 59.0	0.8	0.9
Pressure Maintenance, Repressuring	33,793	244,187	+622.6	2.1	10.6
Transmission Systems	74,130	181,097	+144.3	4.5	7.9
Recycling Plants	42,934	101,731	+136.9	2.6	4.4
Gasoline Plants	1,380,155	1,642,747	+ 19.0	84.0	71.2
Carbon Black Plants	21,273	21,092	— 0.9	1.3	0.9
Vented and Line Losses	11,703	9,996	— 14.6	0.7	0.4
Total Production	1,643,593	2,307,478	+ 40.4	100.0	100.0

Table 4.

Texas Gas Well Gas Production and Disposition

(Thousands of Cubic Feet Daily)

	1945	First Half 1950	Percent Change 1945-1950	PERCENT OF TOTAL 1945	1950
Fuel System, Lease Use	185,382	174,942	— 5.6	3.3	2.1
Gas Lift	179,217	208,350	+ 16.3	3.2	2.5
Pressure Maintenance, Repressuring	30,552	77,752	+154.5	0.5	0.9
Transmission Systems	1,295,588	1,810,358	+ 39.7	23.0	21.6
Recycling Plants	1,914,005	2,124,736	+ 11.0	33.8	25.4
Gasoline Plants	2,042,377	3,940,655	+ 92.9	36.1	47.0
Carbon Black Plants	9,026	44,429	+392.2	0.1	0.6
Vented and Line Losses	2,117	(—) 924	—143.6	0.0	0.0
Total Production	5,658,264	8,380,298	+ 48.1	100.0	100.0

Table 5.

Texas Processing Plant (Gasoline, Recycling, etc.) Operations

(Thousands of Cubic Feet Daily)

	1945	First Half 1950	Percent Change 1945-1950	PERCENT OF TOTAL 1945	1950
No. of Plants End of Period	204	310	+ 52.0	....	....
No. of Wells End of Period:					
Oil Wells	46,107	59,382	+ 28.8	....	....
Gas Wells	2,062	3,708	+ 79.8	....	....
Total Wells	48,169	63,090	+ 31.0	....	....
Intake (Inc. Gas from Other States):					
Casinghead (Oil Wells)	1,392,843	1,924,988	+ 38.2	25.0	23.6
From Gas Wells	3,990,685	5,935,163	+ 48.7	71.5	72.6
Other Sources (Refinery Vapors and Pipe Lines)	193,537	311,187	+ 60.8	3.5	3.8
Total Intake	5,577,065	8,171,338	+ 46.5	100.0	100.0
Residue Disposition:					
Extraction Losses	239,953	382,608	+ 59.5	4.3	4.7
Plant Fuel, Lease Use, Fuel System	454,616	631,023	+ 38.8	8.2	7.7
Gas Lift	66,179	134,937	+103.9	1.2	1.7
Pressure Maintenance, Repressuring	297,917	496,857	+ 66.8	5.3	6.1
Recycling	1,415,032	1,557,265	+ 10.1	25.4	19.0
Carbon Black Plants	982,572	737,764	— 24.9	17.6	9.0
Transmission Lines	1,808,457	4,167,970	+130.5	32.4	51.0
Vented and Line Losses	312,339	62,914	— 79.9	5.6	0.8
Total Disposition	5,577,065	8,171,338	+ 46.5	100.0	100.0

natural gasoline plants vented and burned in the air marketless casinghead and residue gas to get rid of it.

Especially since World War II, great strides have been taken in putting to use the gas produced in Texas and in eliminating venting and other losses. At present, only six-tenths of 1 percent of the total gas being produced in Texas is accounted for by venting and line losses. This is the record for the first six months of 1950. As recently as in 1945, 4.5 percent of the total production went into venting and line losses.

While the present operations do not represent perfection in gas conservation, they approach it. Of the relatively small volume of gas now vented and otherwise lost, a material part is gas that cannot be practically or economically saved, such as casinghead gas from isolated wells and residue gas at plants for which there is no existing market or practical use.

As a matter of fact, even much of the gas now conserved is being saved only through costly facilities and heavy investments that must yet prove their economic justification.

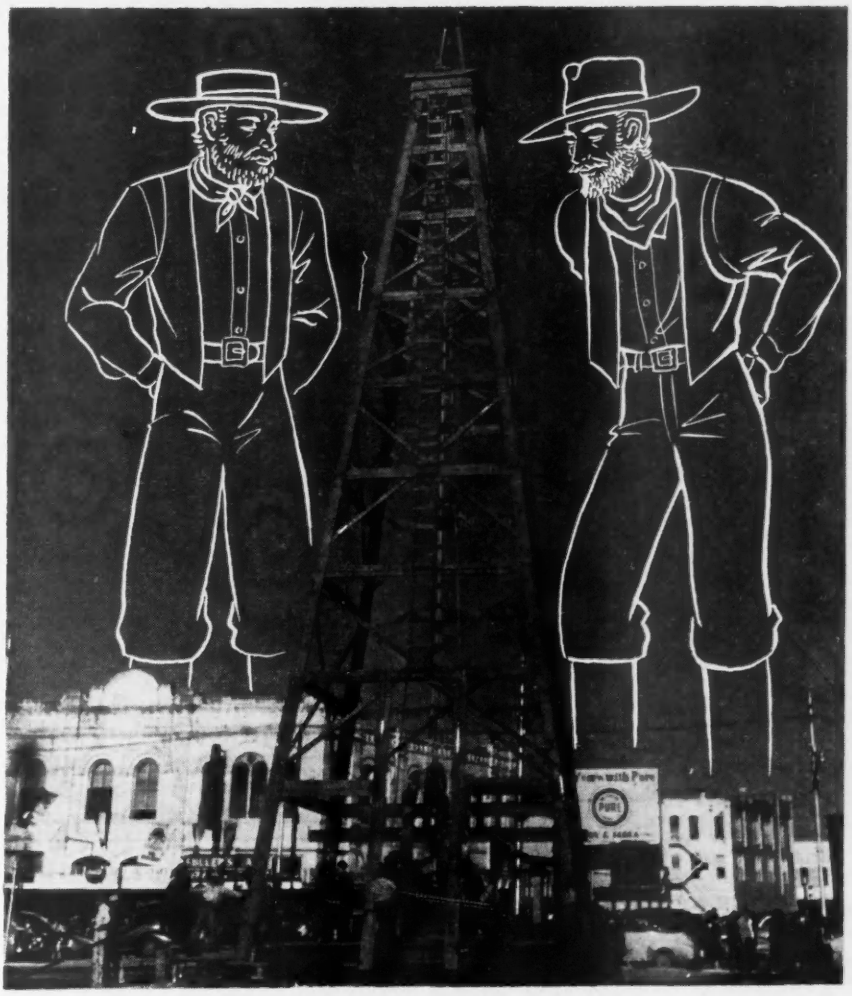
One of the most important factors in bringing about the recent great progress in natural gas conservation in Texas has been the sharply increasing economic value and price of the gas. Gas always has possessed great intrinsic value. But it has been only in recent years that industry, business, and domestic consumers have widely recognized this intrinsic value and more widely gained access to this fuel. In heating value, natural gas in the amount of 6000 cubic feet is roughly equivalent to one barrel of oil, and 24,000 cubic feet is roughly equivalent to one ton of coal. At recent and present prices, natural gas therefore is relatively cheap as compared with oil or coal, even though the delivered price may include the cost of moving the gas by pipe line across the nation. Furthermore, natural gas has some important advantages over other fuels, aside from price, including its high efficiency, convenience, clean nature, and flexibility.

In taking Texas natural gas to markets, near and far, the pipe line systems have provided larger and wider markets and thereby have advanced the market value and price that Texas gas will bring. In this way, the expanding pipe line outlets are playing a major role in promoting maximum utilization and minimum waste or loss of Texas gas.

Progress of recent years in the chemical synthesis of petroleum hy-

■ CONTINUED ON PAGE 42

The GIANTS Came Home



Replica of Lucas Gusher

THE giants came home to old Spindletop last month.

On the ground where they sowed the faith and courage and strength of their youth, they returned to reap homage from thousands who feasted and paraded and preached and praised in a week-long celebration opening a year-long observance of the 50th anniversary of the Lucas Gusher at Beaumont.

It was on January 10, 1901, that the earth belched like a cannon shot to herald the fabulous and perhaps fateful well that made oil an industry; that gave the world wings to fly to glory—and the atom bomb to blow itself there.

Three of the returning goliaths had made big tracks indeed in the quagmire of Pearl Street, where some say a drunk stumbled and quietly drowned, and where the muck splashed and sucked at the hooves of as many as 24 mules groaning at a laden wagon, but which last month was paved and clean beneath the young, happy feet of 12 tootling bands.

One who was there was Pattillo Higgins, who is tall in the history books as the man who had The Dream. Higgins' dream, which stands proudly alongside "Drake's Folly," was at first just a modest, wistful little thing. He wanted to get oil at Spindletop so he could fuel a brickyard right there on old Round Hill. But dreams, like men, like nations, either wilt or grow stubbornly strong under a bitter diet of opposition and derision; so Higgins' dream grew big beyond the hope of gain, which was why, after the company he formed had broken its heart with two failures, and he advertised a bravely pathetic plea in an Eastern trade journal and enlisted the aid of Captain Anthony Lucas, he accepted an interest of only 10 percent in the revitalized venture.

Two other giants there last month were Curt and Al Hamill, who with brother Jim and Peck Byrd had put muscles in old Pat's dream. Tough, skillful, ingenious, they brought off one of the great achievements of oil well drilling when, facing disaster through loss of circulation, they mauled, cursed and sweated 285 feet of eight-inch pipe through sand and landed it on the gumbo lid of the Spindletop treasure chest—and all for $2 per foot.

Another giant who perhaps was there on the sidelines, though never once was he jostled by the throng, was the Captain himself, who had some of Pattillo's vision and some of the Hamills' toughness, and all their ingenuity and more. Without him, or a man mighty like him, Spindletop could not have been. This most noted well in U. S. history, which opened the Gulf Coast for major production and proved the existence of oil around salt domes, was also the first great well drilled by an engineer, and a well that only an engineer could have drilled.

If Captain Lucas was on hand, there must have been other towering shadows beside him. Big ones like John Galey, the Pittsburgh genius of the Guffey and Galey firm who financed Lucas when the captain, like Pattillo before him, finally reached the desperate point where nothing mattered except to find what was down there; and such as Marrs McLean, another persistent dreamer like Pattillo, who brought on the second Spindletop boom in 1925 by persuading Frank Yount that the numerous deep, dry holes on the flanks of Spindletop were not to be believed.

Last month's celebration opened January 4 with eloquence flung to a nation over Gulf Oil Corporation's "We the People" radio and television show dedicated to Spindletop.

And it had been only 50 years before that the county judge stopped

Pattillo one day before a snickering sidewalk audience. "Listen to me, Bud. You claim there is oil here worth millions of dollars. Why, do you know that all the property in the county is on the tax rolls for only $3 million?"

There was a Spindletop song saga, merchants decorated their windows with a "then and now" theme, and there was the unveiling of the Lucas Gusher replica, a modern power rig, and the newspapers publicized the delicate creation of derrick hair-dos for two Beaumont beauties.

Fifty years before, unnoticed by all, four men toiled over another derrick. "It turned out to be quite a job for us to do alone," recalled Al Hamill, "for in the Corsicana field, we had experienced derrick crews who erected all derricks. We laid the lumber out on the ground in the shape of a derrick and cut it to shape from this pattern. This worked fine . . ."

The Spindletop Commission Sunset Park 1 was spudded in, the Spindletop Hall of Exhibits was opened, and sermons were delivered on the general theme: "Spindletop is God's gift; man only unearthed it."

In January, 1901, while the Gusher was soaking the prairie with 100,000 roaring, spewing barrels of oil per day, and the whole town had the jitters, a few ministers were saying that "man had no right to disturb nature" and "the land will cave in from the oil being taken from the bowels of the earth."

There was a Spindletop art show, proclamations by Mayor Otho Plummer of Beaumont and Governor Allan Shivers. du Pont broadcast its Cavalcade of America with Cinemactors Robert Cummings and Teresa Wright as Captain and Mrs. Lucas.

That other January began cold and miserable for those in the frame house on Highland Avenue, and when the money was gone, Mrs. Lucas chopped up some of the furniture to make a fire and sold the rest for food. Then she made makeshift furniture from drygoods boxes covered with calico.

U. S. Steel Corporation presented its national radio show, "Theater Guild on the Air," and a special train arrived from Houston with 300 geologists and other oil men.

Trainloads of frenzied men were arriving daily in late January 50 years ago, and one man leased a Pullman berth for 30 days to have a place to sleep. Some arrived wearing badges, "Oil is Well in Beaumont" and a story in The Beaumont Journal expressed pleasure that a train from Galveston was jammed with 1500 excursionists, although it had been announced that the "well had been entirely closed and would not be allowed to again spout for the benefit of the public."

There was an hour long Spindletop 50th Anniversary Parade of Progress; 50,000 people saw it; and the roof of an old building collapsed.

In 1901, this building had housed the American National Bank, which took in so much money that it overflowed the vaults and was stacked in the lobby under the surveillance of armed guards.

Commemoration services were held at the Lucas Gusher Monument, and some lingered afterwards at the base of the graceful 58-foot granite shaft.

They could have been admiring the stone.

They could have been thinking of the inscription: "Petroleum has revolutionized industry . . . it has altered man's way of life."

Or they could have been wondering if the faith and the hope and the courage of man, which this monument commemorates, still exists in sufficient strength to carry civilization through its present crisis.

Fewer Flares in Texas

■ CONTINUED FROM PAGE 40

drocarbons also has opened a vast field of chemical manufacture of innumerable important products from natural gas, providing a substantial and increasingly important new market for the gas. These plants for making liquid fuels and chemicals from natural gas are due a part of the credit for enhancing the value of gas and promoting its conservation.

It has been estimated that since the war, oil and gas companies have invested more than $1¼ billion in approximately 140 gas conservation plants to conserve about 2½ billion cubic feet daily of casinghead gas.

Casinghead gas is that produced from oil wells along with the oil. About 60,000 Texas oil wells are now connected with gathering systems and plants for utilizing this gas, according to William J. Murray of the Texas Railroad Commission. The amount processed in July, 1950, totaled 2372 million cubic feet daily, with only about 2 percent of the processed gas being flared, he stated. In contrast, he added, 1211 million cubic feet were processed and about 27 percent flared in March, 1945.

Credit for progress in gas conservation in Texas is due both the industry and the Texas Railroad Commission. While much attention has been directed to the mandatory orders of the Railroad Commission, probably far more has been accomplished through efforts to work cooperatively with industry in finding means to conserve gas, Murray told members of the Texas Mid-Continent Oil and Gas Association at their annual meeting recently. He cited the work of the Industry Gas Conservation Committee, appointed by the Railroad Commission, as a forerunner of the state's vast plant construction and gas conservation program.

While the past several years have brought remarkable results in conservation of natural gas not only in Texas but also in Louisiana, Arkansas, and other states, there is now much fear that gas conservation and utilization will be seriously hampered in the future by federal government interference. The Federal Power Commission now is actively seeking to assert broad new powers over production and sales of natural gas at the wells, including the fixing of prices and determination of return on investment.

It seems evident that if the commission successfully assumes these powers, they will be promptly extended also to production and sales of oil produced along with gas. The commission seeks to fix prices received by a producing company under the federal Natural Gas Act, though the law specifically exempts from FPC regulation the producers that are strictly producers and not engaged in gas utility operations.

Rather than to become subject to regulation as utilities, many oil and gas producers would withdraw entirely and decline to enter operations involving the selling of gas. The gas would become a deadly product of economically ruinous potentialities.

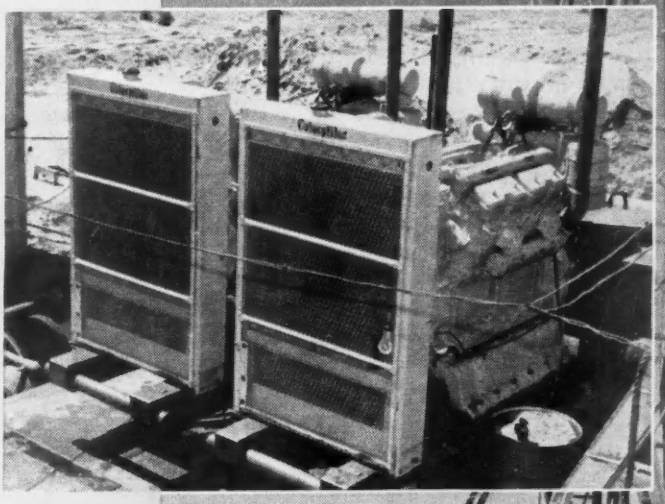
This political danger definitely and deplorably damages gas conservation and puts a serious damper on widening of natural gas markets and utilization, affecting not only Texas but also all other states where gas is produced. Since the President and the Supreme Court have encouraged FPC to assume the power to regulate gas production through misinterpretation of the existing law, the FPC regulation probably can be effectively forestalled only by new Congressional action, spelling out the already clearly expressed intention of Congress to exempt gas production operations from FPC regulation.

A couple of new hands make good!

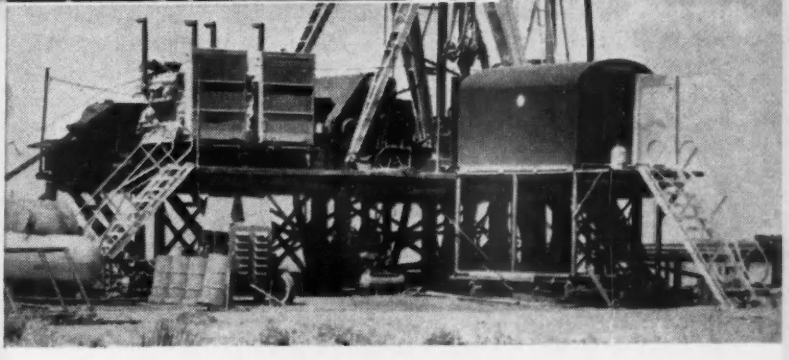
Typical of the reports coming in about 'Caterpillar's" big new Oilfield Engines is this one from W. B. Barnett, driller for the Western Drilling Co., Lubbock, Texas. He says: "For twenty-four-hour service, efficiency and ease of operation, the two D375 'Cat' Oilfield Engines we have are the best I have operated."

These two D375s are compounded to drive the Oil Well mud pump and Emsco drawworks on this 8,500-foot rig in operation at Whiteface, Texas. When this picture was taken, the hole was down to 4,400 feet, with 600 to go. Time-table for the setup: rig up, 10 days; drill, 13; complete, 16; tear down, 1.

"Cat" Oilfield Engines, in 10 sizes up to 500 HP., are designed for rugged oilfield duty. They're compact, yet they deliver plenty of power—their rating is honest. They're tough, built to stand up under the roughest rig service. And they're dependable, engineered to stay in there pitching with a minimum of down-time. For your electrical needs, "Caterpillar" Diesel Electric Sets are built in 10 sizes up to 314 KW.



There's another big plus for you when you use "Caterpillar" power. That's the on-the-job service from your "Caterpillar" dealer, on call day and night. His servicemen are skilled and his up-to-date shop is well stocked. Under current conditions, you'll find it well worth your while to talk over your requirements *now* with him.



LOOK UNDER THE HIDE

"Caterpillar" fuel lines are made of cold-drawn seamless steel tubing. All lines are the same length to give identical spray characteristics at each cylinder. Able to withstand pressures of 3,000 to 5,000 lbs. per sq. in., the metal is hard yet capable of being cold-formed without excessive spring-back. The bore is free of injurious cracks and seams and has uniform diameter. Look under the hide for built-in quality.

CATERPILLAR, PEORIA, ILLINOIS

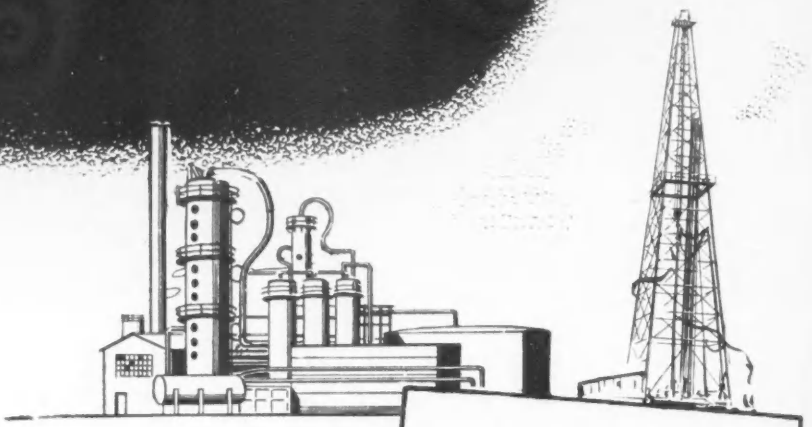
CATERPILLAR

REG. U. S. PAT. OFF.

OILFIELD ENGINES

Oil Joins Other Industries in *Upholding Free Enterprise*

By HENRY OZANNE
Eastern District Editor



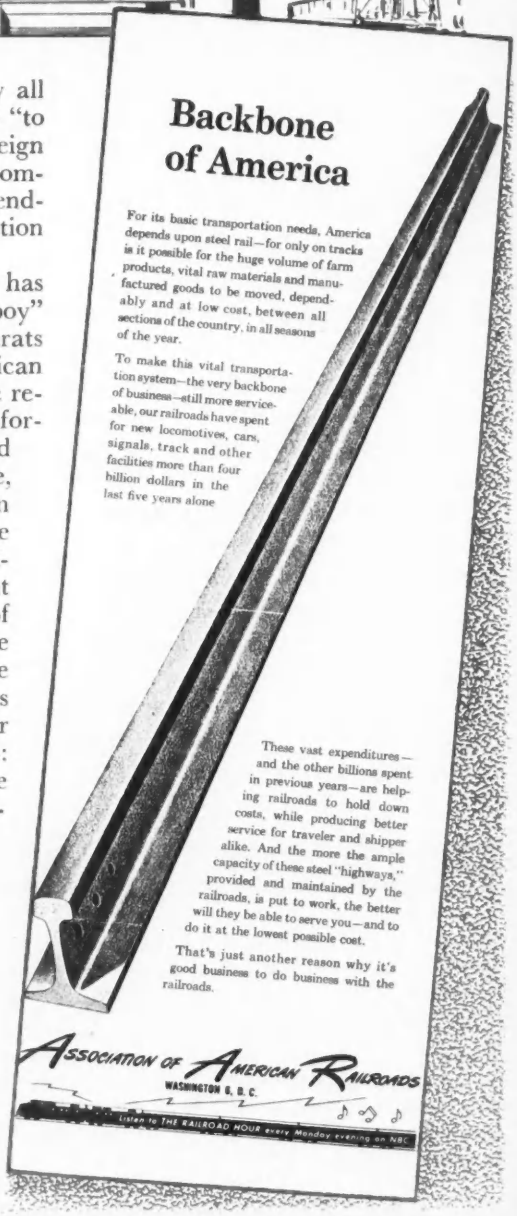
THE oil industry has been hesitant in openly championing the American free enterprise cause, and many industry leaders feel its timidity has deprived business of oil's needed weight in the fight against government encroachment on private business and personal rights. "Free enterprise needs a soapbox, too," in the words of the editors of *Fortune* who made a recent survey of the means that American business is taking to "sell itself" to the American people. And there is indication that a number of petroleum company top officials are abandoning their traditional pedestal of dignified silence to speak their piece on the necessity of preserving the American way of life.

One of these is T. S. Petersen, president of Standard Oil Company of California, who has censured government dictatorial tactics in talks throughout the U. S. He even wrote a letter to President Truman in which he argued "the public good is best served by immediate removal of any possible restraints on competition rather than to hold a matter secret until the Department of Justice thinks it has accumulated enough material for a show in court."

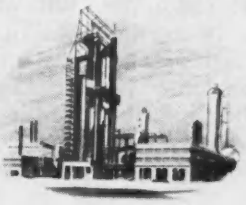
Another ardent spokesman for the cause of free enterprise is Robert G. Dunlop, president of Sun Oil Company, who has fought back vigorously at the Justice Department's anti-trust charges brought against the company. Still another is Dr. Robert E. Wilson, board chairman of Standard Oil Company (Indiana) who warns that the problem faced by all business units—large or small—is "to win the fight to help the sovereign people of this land realize that competition between free and independent units is the only sound protection of their real interests."

But the oil industry too often has accepted the role of "whipping boy" for the politicians and bureaucrats without striking back. The American Petroleum Institute and its public relations arm, the Oil Industry Information Committee, are prohibited from political activity. Furthermore, petroleum leaders have not been conspicuous on the forums of free enterprise, and the companies typically have confined their comment to mildly-tempered eulogies of "freedom" without any bare knuckles defense of the concrete consequences of that freedom. As Frank Abrams, board chairman for Standard Oil Company (N.J.), says: "It always seems rather sad to me that we of the industrial and busi-

IN CONTRAST with former silence under attack by politicians and bureaucrats, men of the oil industry, tired of the role of whipping boy, are beginning to talk back publicly to defend themselves, their industry, and the American freedom under which they have operated, to the advantage of the consumers as well as themselves and their companies.


Backbone of America
For its basic transportation needs, America depends upon steel rail—for only on tracks is it possible for the huge volume of farm products, vital raw materials and manufactured goods to be moved, dependably and at low cost, between all sections of the country, in all seasons of the year.
To make this vital transportation system—the very backbone of business—still more serviceable, our railroads have spent for new locomotives, cars, signals, track and other facilities more than four billion dollars in the last five years alone
These vast expenditures—and the other billions spent in previous years—are helping railroads to hold down costs, while producing better service for traveler and shipper alike. And the more the ample capacity of these steel "highways," provided and maintained by the railroads, is put to work, the better will they be able to serve you—and to do it at the lowest possible cost.
That's just another reason why it's good business to do business with the railroads.
Association of American Railroads
Washington 6, D. C.
Listen to THE RAILROAD HOUR every Monday evening on NBC

HOW BIG



SHOULD AN OIL COMPANY BE ?

HERE IS A STRAIGHT ANSWER FROM ONE COMPANY

To put it another way:

A *company* is as strong as its competitive efficiency —

In turn, an *industry* is as strong as its companies —

And in turn, a *nation* is as strong as its industries.

any, big or little, must interests

BIGNESS COMES IN HANDY!

In Peace—In War!

Medals for millionaires

THERE are more than 100,000 jobs at Ford Motor Company because Henry Ford went into business to make money—and succeeded. He made millions for himself, hundreds of millions for others. He created 100,000 jobs paying workmen more of the better things of life than any state-owned industry here or anywhere else in the world will or can ever pay its workers.

There are more than 100,000 jobs on the New York Central Railroad because Cornelius Vanderbilt, a poor boy, determined to become rich, and did . . . and built a great business in the process.

These men and hundreds like them—because they wanted to make money—went into business, worked day and night, made a little money, invested it in better machinery. This made more money—and so the business grew, with more and more jobs paying higher and higher wages made possible by improved machinery bought out of profits. (And in the process these companies turn out better and better products and services at lower prices.)

It is the hope of profit that has been the spark plug of America. Take it away and the magnificent machine that is America will stall—and workers' progress will stop dead with it.

WARNER & SWASEY *Cleveland* Machine Tools Textile Machinery

YOU CAN MACHINE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY TURRET LATHES, AUTOMATICS AND TAPPING MACHINES

"—life, liberty and the pursuit of happiness"

THE CONSTITUTION doesn't guarantee you happiness—just right to *pursue* it. Self-respecting people could want no m

George Washington was *pursuing* the happiness of a rich plan and to attain it he founded a nation.

Abraham Lincoln was pursuing a profession, and in the proces

A hundred thous happiness

Communists and capitalists agree on shorter hours, higher pay

THE DIFFERENCE is that capitalism produces it, communism destroys it.

That picture is of a sign on the platform of a communist-directed union convention. Shorter hours and correspondingly less work, with same or higher pay can only mean higher costs, fewer customers and so more layoffs. That is, of course, the communist technique.

Capitalism (or the profit-and-loss system or Americanism, whatever you want to call it) doesn't just *talk* shorter hours and more pay—it *delivers* them. Over the past 30 years in the U. S., in spite of depressions, wars and material shortages, the average hours worked by all workers has gone *down* from 46.3 to 39.1 a week while the average pay has gone *up* from $22.08 a week to $54.66.

Communism and socialism may talk, but Americanism delivers. That's because America has the machines to make a workman worth more, machines paid for out of saved American profits.

WARNER & SWASEY *Cleveland* Machine Tools Textile Machinery

...CHINE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY TURRET LATHES, AUTOMATICS AND TAPPING MACHINES

Socony-Vacuum Oil Company's advertisements are effective counter-measures to the opinion popular in Administration circles that it is bad to be big. Warner & Swasey hammers at the Free Enterprise theme.

ness world deceive ourselves that we can 'make friends and influence people' through such things as paid newspaper advertising, pamphlets and billboards. Some of that may help under certain conditions. But when it becomes the main channel of our effort, I think it is almost an insult to the intelligence of the average reader."

Other industries are not so cautious. The *Fortune* survey finds that the Advertising Council alone has inspired 8000 outdoor posters on the free enterprise theme, 136,000 car cards, and 3 million radio "listener impressions." The magazine reports:

"All in all, the free enterprise campaign is shaping up as one of the most intensive 'sales' jobs in the history of industry—in fact it is fast becoming very much of an industry in itself. This year it will probably account for at least $100 million of industry's ad budget and an unknown but hefty share of its employe-relations expenditures. More to the point, it is absorbing more and more of the energies expended by the top men in U. S. management."

Warner & Swasey Company, machine tools, of Cleveland, has done a remarkable job in publicizing the story of free enterprise. The company has run advertisements in many prominent magazines under such captions as "Share the Work Only Shares Poverty," "Medals for Millionaires"; etc. In a widespread booklet entitled " . . . And the Truth Shall Make You Free," Warner and Swasey warn:

"There are those in America who —from greed or envy or lust of power —are trying to sow the seeds of discord and strife at home . . . they set one group against another; they present as new cure-alls old tricks that have failed 10,000 times in history. They are following the formula that leads to dictatorships, to the enslavement of labor and to future war."

It is rare that this kind of hard-hitting language comes from the petroleum industry. And industry is not agreed fully on the merit of this kind of "frontal attack." For instance, one of the most articulate of the "big business" units, E. I. du Pont de Nemours & Company, does not attempt to sell the free enterprise system. In fact it usually avoids direct reference to that subject in an effort to promote understanding of the du Pont Company and its business function in the American economy, believing that once that understanding has been achieved, the company will be liked by the American people.

Recently, however, du Pont expanded its promotional activity through a symposium for educators which was attended by professors from 40 universities. Discussions were held on many relevant topics, such as "The role of technological advancement and the demands it has placed upon capital resources; the investment in tools and equipment, brains and know-how."

Crawford H. Greenewalt, du Pont Company president, summed up the philosophy of free enterprise before the Congressional Sub-Committee on Monopoly Power of the House Judiciary Committee, in these words:

"Competition must inevitably mean that someone wins and someone loses, whether we are discussing football, politics or business. If we learn how to make for sale something that the public wants at 25 cents, when the present price is 30 cents, I think we will take business away from someone else and he will get hurt. If someone else learns to make it for sale at 20 cents, we will get hurt. But in either case, the consumer holds the winning ticket."

Greenewalt gave a forcible address to the National Press Club in Washington in which he said:

"The du Pont Company has existed for nearly 150 years in an atmosphere of free and vigorous competition. We have done well under that system and we like it. We think we are stronger because of it; we think we would be weaker without it. It is utter foolishness to think that growth in any of its varied phases can be brought about only by the elimination of other manufacturers.

"It should be obvious that big businesses are essential in the complex economy in which we live today. A business is simply a pool of people's resources—the resources of a group of employes, of a group of investors to accomplish a given task. Since there is a limit to what any man will risk, the larger the task the bigger the pool must be."

Another champion of free enterprise has been International Harvester, which has stressed the theme

Profits at work
now . . . and in the future!
In 1948, International Harvester had the largest sales and dollar profit in its history. However, rate of profit per dollar of sales—4.7 cents—was the lowest of any normal period in many years. It was only three-fifths that of 1941, when rate of profit was 8.3 cents.
8.3 CENTS PER DOLLAR OF SALES
4.7 CENTS PER DOLLAR OF SALES
1941
1948
PROFIT PER DOLLAR OF SALES 43.4% LESS IN 1948 THAN IN 1941
On sales of 945 million dollars, our profits were $44,909,000. The company also had income of $10,770,000 in dividends from subsidiaries and in miscellaneous income, making a total profit after taxes of $55,679,000. Of this, slightly less than half was paid in dividends—$27,155,090. Slightly more than half—$28,524,000 was plowed back into the business. Dividends from operations in foreign countries represent a substantial part of the money plowed back.
"Profits plowed back" are profits at work
"Profits plowed back" are not so many actual dollars under lock and key in banks. They are not like the money that King Midas used to admire just for money's sake.
They are profits at work—now and in the future! They are money in new production lines and new equipment. They are money in parts and inventories of all kinds.
From 1941 through 1948, International Harvester has built six new plants, has made extensive improvements in existing plants, and has greatly increased inventory. "Profits plowed back" in the business—from both domestic and foreign operations—provided $113,600,000 toward this.
How have "plowed back" profits benefited our employes, customers, and stockholders?
Profits at work for employes
57,400
94,700
1941
1948
It is our policy to provide well paid jobs, with ample opportunities for advancement, at good places to work, to the largest number of men and women who can be productively employed. "Profits plowed back" have helped in increasing the average number of employes from 57,400 in 1941 to 94,700 in 1948. Average earnings have increased 92.6% for non-salaried factory workers; 84.0% for non-managerial salaried employes; 83.0% for managerial salaried employes.
Profits at work for customers
TRUCKS
1948—165,600
1947—148,700
TRACTORS
1948—146,777
1947—110,937
REFRIGERATION
1948—128,397
1947— 35,005
"Profits plowed back" have aided in the development of our extensive manufacturing research facilities and in the creation of new products such as the little Farmall "Cub" Tractor, the cotton picker, refrigeration, and many other items. They have contributed to our expanded plant capacity which has made it possible to furnish customers with more goods at the lowest possible prices.
Wages and materials are the principal items of cost that govern our prices. You have seen how much wages and salaries have been increased. Government figures show that the prices on materials have increased 81% since 1941. Price on metals and metal products is up 78%. But the price increases on IH products are less than any of these figures. They have been 72.0% on motor trucks; 74.0% on industrial power products; and 60.0% on farm machines.
Profits at work for stockholders
The 46,000 IH stockholders are a cross section of all groups—farmers, housewives, factory workers, and others. In 1948, dividends paid on common stock represent an increase in "wages" of stockholders of 63% over 1941
Profits at work in the future
Profits at work made it possible for International Harvester, in 1948, to *serve more people*—employes, customers, and stockholders—*in greater measure than ever before*. By continuing to earn a profit, we hope also to continue to serve more people in greater measure than ever before.
Profits mean progress for everyone
INTERNATIONAL HARVESTER

"Profits Mean Progress for Everyone" is International Harvester's common-sense message.

Take care of your wire rope

Here are a few simple rules that will prolong its life

1. Select wire lines of the correct size, construction and grade for your particular conditions.

2. Buy it *long* enough to permit a number of changes in position on the drum.

3. Do not overload the rope. Determine your maximum loads and follow the recommended factor of safety. No rope can survive overloading.

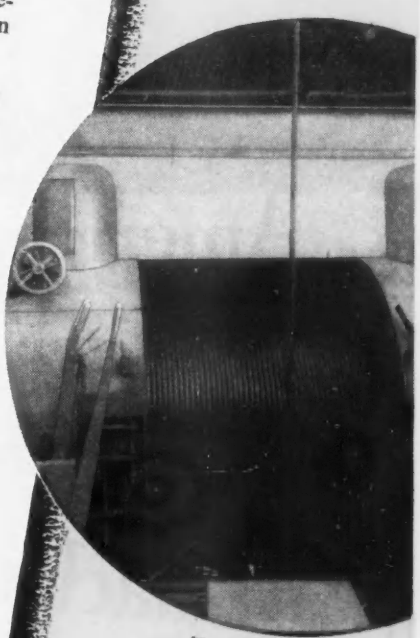
4. Check sheaves regularly to be sure the grooves are not undersized. All sheaves should be properly lubricated and in line.

5. Keep your wire ropes well lubricated. American Tiger Lube was designed especially for wire rope lubrication. It does not "throw" in hot weather and it retains its lubricating qualities in the coldest weather.

6. Avoid sudden jerks. Running into the load instead of picking it up smoothly puts an undue strain on the rope structure.

7. Avoid kinks, uneven spooling on drums and reverse bends.

8. Don't speed. Sudden acceleration and deceleration may cause whipping and uneven spooling on the drum. High speeds cause excessive wear.



USS AMERICAN TIGER BRAND WIRE ROPE UNITED STATES STEEL

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

SEND FOR THESE BOOKLETS

American Steel & Wire Company
Rockefeller Building, Dept. Q-2
Cleveland 13, Ohio.

Please send me: "American Tiger Brand Wire Lines for Oil, Gas and Water Wells." "Valuable facts about the use and care of Wire Rope."

Name.....

Company.....

Position.....

Address.....

AMERICAN TIGER BRAND WIRE ROPE

USS TRADE MARK *Excellay Preformed*

UNITED STATES STEEL

on its "Harvest of Stars" radio program. Here is a message from one of these programs:

"International Harvester is engaged in several fields of business; in every one of these fields we have many alert, aggressive and successful competitors. We take pride in the fact that we sometimes take a step ahead of our competitors. We are not so proud in admitting that many times they take a step ahead of us. It is these steps forward, first by one competitor and then another, that give the consumer an even better product. This is the mainspring of our American business system."

International Harvester distributed to the public a report of the company's operations for 1949 under the title, "Competition Means Progress," emphasizing the free enterprise theme.

A vigorous defender of the free enterprise system through advertising and other public appeal messages is Standard Steel Spring Company. In full page ads, this company ran a series of such messages giving statistical breakdowns on earnings, costs, and profits. One of these ads was captioned "Would You Wreck American Business for $15.33?" Another was entitled "Shackle Profits and You Invite National Suicide."

The United States Steel Corporation, through the addresses of its president, Benjamin F. Fairless, has been extremely active in spreading the free enterprise story. Fairless has sharply attacked the bureaucratic methods of congressional "inquisitors" masking under the pretense of objective fact-finding bodies, and has repeatedly pointed out the danger to American business in such tactics.

One of the most elaborate publications yet issued and dedicated to the cause of free enterprise is U. S. Steel's 172-page book "Business Big and Small Built America," containing statements by company officials before the Monopoly Subcommittee of the House. This expensively produced book, distributed without charge, contains photographs, charts and factual analysis of many of the problems of contemporary business.

Still another industrialist who has taken up the cause of free enterprise is Harvey S. Firestone, president of Firestone Tire and Rubber Company, many of whose talks before business and civic clubs have been reprinted in booklet form for mass distribution.

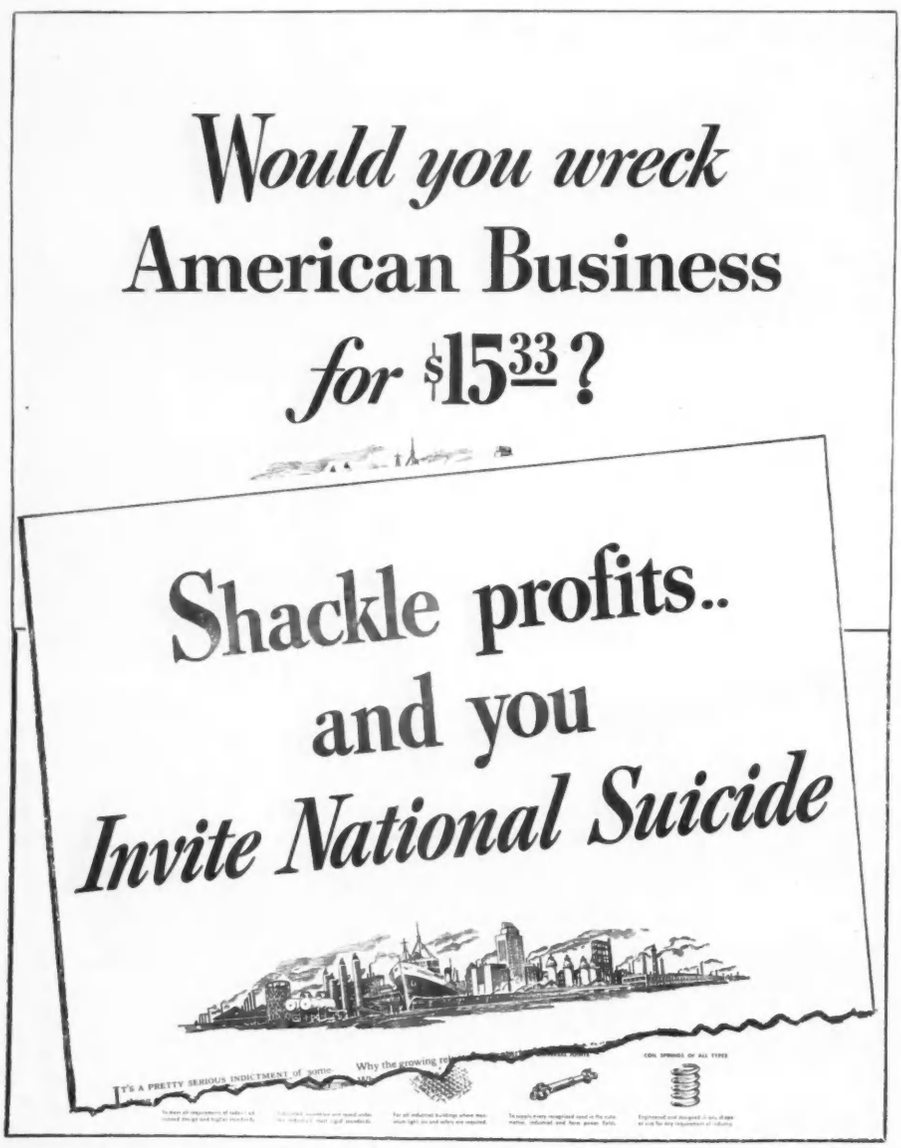
The Prudential Insurance Company of America has become noted for the work it is doing in publicizing the American way. Its president, Carrol M. Shanks, makes a practice of talking free enterprise in all of the many public addresses he gives throughout the country. Even at the company's regional and national sales meetings, Shanks never fails to "sell the American way."

Radio and television are effective means for carrying the story of free enterprise to the American people, but TV work along this line has lagged to date. However, a number of radio shows stress the free enterprise message, such as "The Railroad Hour" of the Association of American Railroads. In addition, the Railroad association has carried many advertisements in the principal magazines under captions such as "Backbone of America," underlining the advantages of the competitive system.

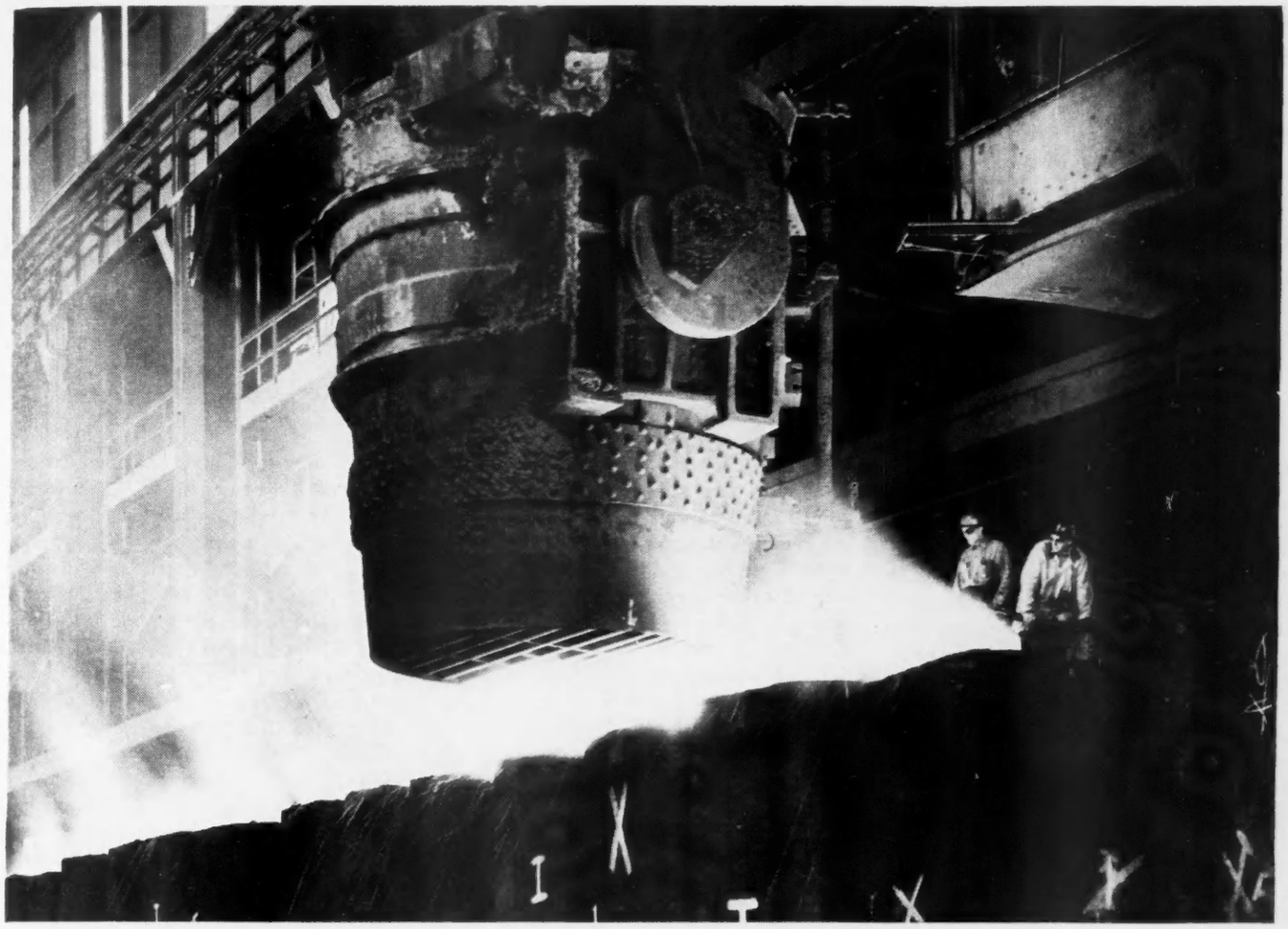
Socony-Vacuum Oil Company, Inc., is one of the few units in the petroleum industry that has dealt with the monopoly question. Under a general discussion of "Bigness," the company has pointed out in a series of color advertisements the benefits of the American production system.

Recently new voices from oil have been raised in resistance to the encroachment of government. Robert L. Minckler, president of General Petroleum Corporation, advises that the time has come to speak out plainly against anti-trust politics and politicians. Don't let the battle for public opinion and private enterprise go by default, he urges. Charles S. Jones, president of Richfield Oil Corporation, also has hit back hard at the bureaucrats. He warns: "If the government should win the socialistic aspects of its suit, it is inevitable that the majority of 30,000-odd dealers in petroleum products in the West would be destroyed."

This kind of talk from oil men is something relatively new, and indicates that perhaps the voice of the petroleum industry will soon be raised more unanimously and more effectively than ever before in the cause of free enterprise and telling the story of its benefits to the American people.



Standard Steel Spring Company is a staunch and outspoken defender of the American business system.



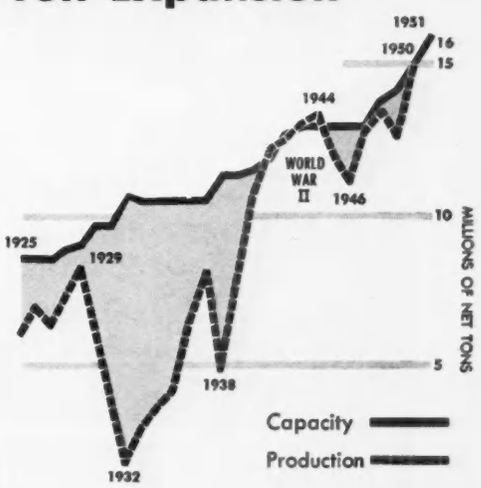
MILLION TONS MORE STEEL

Latest Increase in Bethlehem's Annual Capacity Climaxes 5 Years of Postwar 3,100,000-Ton Expansion

On January 1 of this year Bethlehem's steel making capacity stood at 16 million ingot-tons annually—*an increase of 1 million tons* over a year ago.

Since the war ended we have increased our annual steelmaking capacity *3,100,000 tons, or 24 per cent.*

Moreover, as the chart at the right shows, Bethlehem's steel capacity has nearly doubled in 25 years. Additional capacity can and will be created as it is needed.



BETHLEHEM STEEL ★ BETHLEHEM STEEL ★

Bureau of Mines Role

In Secondary Recovery

Part 2—Conclusion

By R. A. CATTELL
Chief, Petroleum and Natural Gas Section, Bureau of Mines, Washington, D. C.

Rocky Mountain Fields

The Rocky Mountain region is an old oil producing area in which many of the fields are approximately 50 years old. Low pressure gas drives have been in operation in 2 fields in the area for more than 20 years. At present, 14 reservoirs in 9 fields throughout the area are being subjected either to full scale or pilot secondary recovery procedures. A study of these projects is being made in an effort to evaluate the various secondary recovery methods and production techniques as applied to various types of reservoirs. Laboratory and analytical assistance is given to operators of these projects where such work advances the Bureau's research. To this end, cores from many formations and fields are being acquired and studied in the oil well core and fluid analysis laboratory that has been set up and equipped to deal with reservoir characteristics in their many aspects. It is believed that researches and study of the characteristics of the various producing strata in the region will show such similarities of factors important in the application of secondary recovery methods that, once recognized, it may be possible to apply secondary recovery techniques with less-detailed analysis of individual fields.

Special Field Problems

Location of Abandoned Wells

The detection of improperly plugged and abandoned wells is one of the most perplexing problems when a new waterflooding project is being developed. Before adequate laws regarding plugging of wells were enacted, many abandoned wells were plugged ineffectively, and consequently these wells may leak oil and water to the surface or into shallow fresh aquifers when the formation is subjected to water pressure. Bureau engineers now are investigating various means of finding these abandoned holes. An Army mine detector has been effective in locating, at depths to 12 or 18 inches, scrap iron that is usually scattered near old wells. The M-scope pipe finder has been effective in following old lead lines that often are buried in place, thereby marking the location of old wells. The device is effective to depths of 5 to 6 feet. Bureau engineers at the Bartlesville Station now are experimenting with a piece of equipment designed and built in the Bureau shops, with which it is hoped detection of actual casing in abandoned wells will be possible. The new instrument is expected to be effective at much greater depths than either the mine detector or the M-scope. Other devices being tried give some promise of locating old holes from which all pipe has been removed.

Use of Radioisotopes as Tracers

The study of the use of radioisotopes as tracers for the movement of subsurface waters will be initiated soon in a recently constructed radiochemical laboratory at the Bartlesville Station. Early last summer surplus radiation equipment for tracer work became available to the Bureau of Mines by transfer from the Atomic Energy Commission at Oak Ridge, Tenn. This equipment, including scaling units, monitoring devices, survey meters, Geiger tubes, and other specialized radiation-detection equipment, is being installed in the new Bartlesville laboratory.

The use of radioisotopes as tracers will offer a possible solution to many problems involving movement of subsurface waters in connection with waterflooding operations. Any tracer that can be added to water at injection wells and positively identified at producing wells will be a boon to reservoir engineering. Attempts to use dyes as tracers have been largely unsuccessful, except where channels exist, because the dyes are absorbed in the sand. Ions employed as tracers often are not recovered because of ion exchange in the formation. Dex-

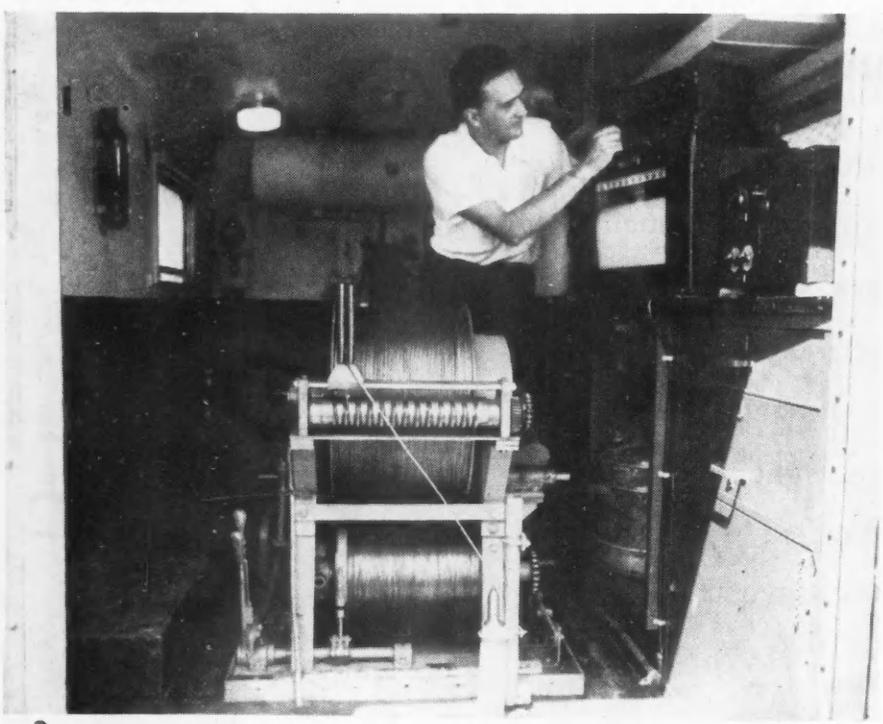
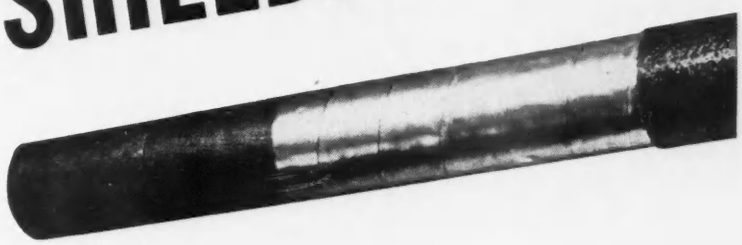


FIGURE 3. Interior of Bureau of Mines mobile laboratory equipped for testing wells on secondary recovery projects, including subsurface pressures and temperatures, input profiles and electric logs.

Power transmission to off-shore wells with the help of...

"326" MONEL SHIELDED CABLE



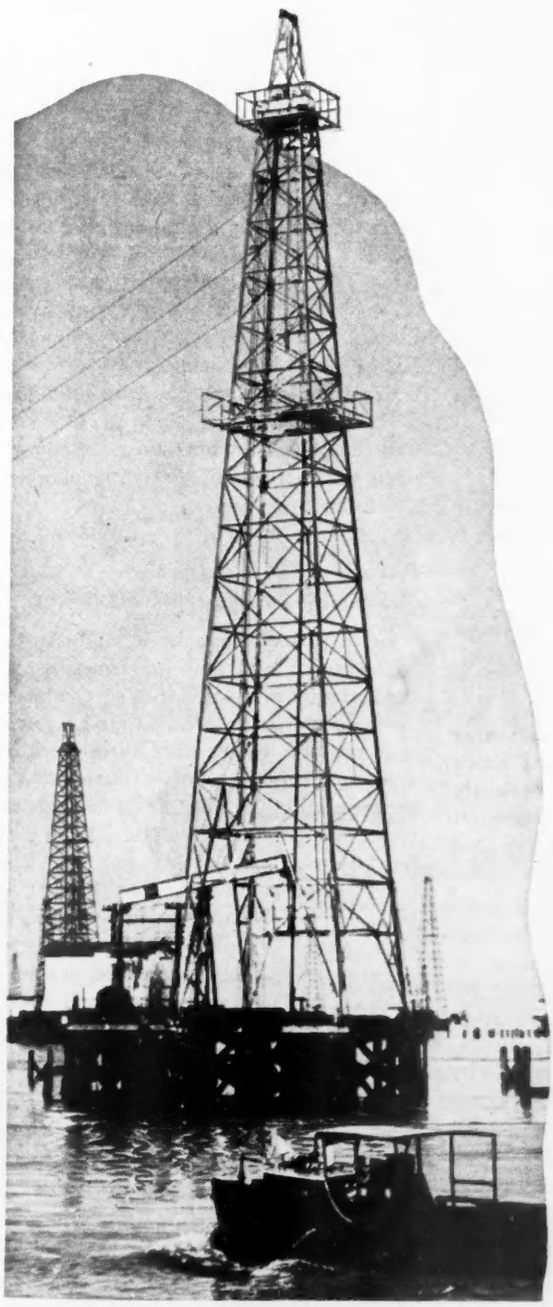


Photo by Vachon, courtesy Standard Oil Company (New Jersey)

Here's the kind of cable that stands up under the severely corrosive conditions of off-shore operation... either carrying power to off-shore wells, or to bottom-hole equipment in these wells.

It's called "326"® Monel Shielded Cable.

"326" Monel—a *non-magnetic* high-Nickel alloy—has many characteristics that make it an excellent shielding material.

Like all INCO Nickel Alloys, "326" Monel is *rustproof* and highly resistant to a long list of commonly-met corrosives. Salt water and sour crudes, of course, are among them.

"326" Monel also possesses high physical properties—strength, toughness, and resistance to abrasion and mechanical damage. And it is readily brazed, soldered and welded.

Because of these characteristics "326" Monel Shielded Cable is a natural for applications where maintenance is not only costly but inconvenient.

And here's another important point. This cable is economical in price. It costs no more than other good metal-shielded cable. In some types, it actually costs *less.*

A number of well-known cable companies make "326" Monel Shielded Cable. ***But right now — with all metals in short supply because of the demands of the national rearmament and defense program — we can't promise how much will be available.***

But there are some things we *can* do. One of them is to be Johnny-on-the-spot when you run into problems involving metals for oil field use. INCO's Technical Service welcomes the opportunity to work with you. Write for their suggestions and recommendations. Naturally, this assistance is yours for the asking—no cost, no obligation involved.

EMBLEM OF SERVICE INCO TRADE MARK

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York 5, N. Y.

trose has been used with only partial success as a water tracer. From information available, it may be stated that no completely satisfactory water tracer is in use at present.

It is believed the use of a radioisotope that emits a hard beta particle or a gamma ray of an intensity sufficient for detection in minute quantities, and with a half-life sufficiently short that any contamination of the reservoir or of surface equipment would be of short duration—thereby permitting a repetition of the tracer tests if necessary—is both feasible and practical. The hazards involved in such a study would be slight, as the activity of the isotope used in tracer quantities would be low.

Another production problem to which radioisotopes appear well suited is a study of the contamination of well cores by drilling fluid. Radioactive tracers later will be an excellent tool in the Bureau's fundamental research program of the nature of surface forces in petroleum reservoirs.[5]

Conditioning Water for Surface Injection

The study of methods of treating and conditioning injection waters to prevent plugging of the oil sands and to reduce corrosion of equipment continues with the Bureau's mobile laboratory unit. Treatment in use at more than 20 water plants in Kansas, Oklahoma, and North Texas have been examined by determining hydrogen ion concentration, carbonate stability, dissolved gases, suspended matter and corrosive effect on special metal discs. In addition to providing valuable information to the operators on the effectiveness of their treatments, reports[6] were prepared describing the treating methods used, the Bureau of Mines test procedures, and the results obtained on injection waters.

Input Rates and Pressures for Water Flooding Oil Sands

The "injectivity index" and the "critical input pressure" of a water input well are important criteria of the intake capacity and the maximum pressure that may be applied without parting the formation and subsequent bypassing of water. A report[7] on a recently completed study explains the procedure used in making these determinations and gives the results obtained from input wells in 9 sandstones that are being water flooded extensively in Mid-Continent fields. The study shows there is no "safe" rule-of-thumb injection pressure in any area and that injectivity indices of wells in each sandstone vary widely, as might be expected from the wide range in permeability observed from cores of each of these sandstones. The study also points to the need of developing better techniques for applying corrective measures on water injection wells because much water is being circulated uselessly through oil-depleted zones in an attempt to recover oil from zones of lower permeability in the same formation.

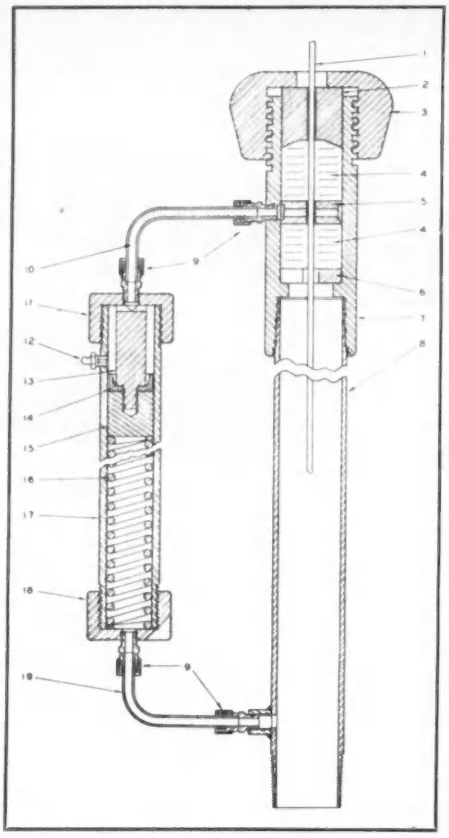


FIGURE 4. Grease packed stuffing box for electric cable.

(1—cable, 2—compression plug, 3—compression cap, 4—rubber seal, 5—lantern grease ring, 6—retaining ring, 7—outside shell, 8—lubricator barrel, 9—compression fitting, 10—grease, 11—cap, 12—grease fitting, 13—plunger stop, 14—leather cup, 15—plunger, 16—spring, 17—grease barrel, 18—bottom cap, 19—gas line.)

Selective Plugging

Recently, the attention of Bureau of Mines engineers has been directed toward perfecting and developing equipment that will permit quantitative evaluation of selective plugging treatments by measurement of input profiles on water input wells (Figure 3). The liquid level gauge was improved and a special well caliper for use with the liquid level gauge was constructed. The caliper is lowered into the well on the same single-conductor Amagraph cable provided for the liquid level gauge and the measurements are indicated at the surface. Frequently, when this cable is used to run instruments to wells that are under pressure, the pressure seal fails to hold the well fluids because of the irregular surface of the spirally wound armored covering. A suitable grease-filled stuffing box was developed for maintaining the seal (Figure 4) and a short article[8] describing the device was published.

Selective Plugging of Air-Gas Injection Wells

In the Appalachian region there is an urgent need for work on selective plugging to develop techniques for applying smokes and liquid suspensions in air- and gas-injection wells. Pennsylvania State College and other organizations have done laboratory work on the plugging of small sandstone specimens with various smokes and liquids, but none of the products has been applied successfully in the field.

The use of water to decrease the effective permeability of fluid-depleted sections of sands subjected to air drive has been tried in the field with some success. A few field experiments have resulted in lower gas injection rates at the same pressures and less channeling of gas but without affecting the oil production rates. These field experiments were made in cooperation with the Pennsylvania State College and results were reported.[9] Experiments have been conducted in the field using liquids containing solid particles in suspension, such as Dresinol, with emphasis on how they can be applied successfully in selectively plugging gas injection wells.

Flowing of Oil Wells on Gas Injection Projects

Great strides have been made in the past several years in determining the fundamental characteristics of producing oil from marginal wells on air-gas injection projects by flowing through small diameter, siphon-type flowstrings. Experimentation in the field proved the technique feasible in wells 300 to 1100 feet deep. Such flowing has not been tried in deeper wells. The flowing of marginal wells in the vicinity of Oil City, Penn., is considered an improved oil production technique and is practiced in several places where reservoir conditions permit. Because flowing permits operating economies not possible with pumping wells, the availability of this technique may be of economic importance to operators of gas injection projects in the Middle district of Pennsylvania and in other parts of the Appalachian region. Bureau engineers now are introducing this practice in the Mid-Continent area. Several reports based on this investigation are being prepared.

Shooting Oil and Gas Wells With Explosives

A threefold approach to the problem of oil and gas well shooting was started to determine how and why an explosive fractures oil and gas bearing rocks and

reduces hazards

cuts loading time

lowers costs

Du Pont Special Oil Well Explosive No. 1

The tremendous spreading action of Du Pont Special Oil Well Explosive No. 1 fractures even the densest strata to promote a greater flow of oil. This increased production is obtained faster, more safely and at lower cost, too, because of the explosive's unique design.

Loads quickly—Light-weight cartridges of S.O.W.E. No. 1 can be strung on a cable in a few minutes. The greater weight load permitted when S.O.W.E. No. 1 is used greatly reduces the number of entries into the hole. Torpedo shells are not needed, and clean-out time and costs are substantially reduced by the elimination of this metal.

There's none safer! Du Pont S.O.W.E. No. 1 is the safest well explosive known . . . so safe, in fact, that even the impact of a high-powered rifle bullet won't detonate it.

Be sure to talk to your American Glycerin Section representative about the advantages of using Du Pont Special Oil Well Explosive No. 1 for your next well job.

How cable-strung cartridges speed work:

Each cartridge of Du Pont S.O.W.E. No. 1 has a hole running through its center from end to end. In assembling charges, the cartridges are strung on a steel cable. Prepared charges are then easily lifted and lowered as a unit into the well. Shells are unnecessary. This new improved method of loading permits making longer, more effective charges and substantially reduces clean-out time.

American Glycerin Section

Explosives Department

E. I. du Pont de Nemours & Co. (Inc.)

Tulsa 3, Oklahoma

DU PONT

REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

FIGURE 5. Bureau equipment used in selective plugging tests on gas injection well.

thereby increases the productivity of shot wells. The study involved: (1) A fundamental investigation to determine experimentally the mechanism of rock fracturing with respect to the physical properties of the rock: (2) a survey to determine the physical properties of the oil bearing rocks obtained from fields throughout the U. S. where well shooting is practiced, so that any correlations developed by the fundamental study may be applied directly to the shooting of oil and gas wells; and (3) an analytical study of present oil and gas well shooting practices in every producing area and the results as measured in terms of production rates before and after shooting.

An experimental program was developed involving the shooting of small diameter holes drilled to shallow depths in a sandstone sufficiently thick and with suitable lithologic properties. Gauges were mounted around each experimental shot hole to determine the strain produced in the rock by the shot. These gauges provide a means of judging the extent of fracturing to be expected, whereas injectivity tests made on the holes before and after shooting show the increased conductivity resulting from the shot.

From the data obtained with preliminary tests, it has been possible to work out a future program of experimental shooting that can be expected to provide valid relationships affecting the design of shots for oil and gas wells to insure maximum increase in conductivity of the well (maximum fracturing), provided the physical properties of the oil and gas bearing rocks are sufficiently well known.

Fundamental Research

Fundamental research on the nature of the forces that hold crude petroleum in the underground reservoir rocks was advanced along three main fronts: (1) Experimental data were obtained and reported on observed surface phenomena at the contact surfaces or interfaces of fluids and solids. In effect, this is a special study of permeability relationships.[10] (2) Surface-active and film-forming substances were extracted from crude petroleum. (3) Interfacial tension studies were made that involve observation of phenomena at the contact surfaces or interfaces of two liquids or of a liquid and gas.[11] The combinations of conditions are manifold, but the present work is restricted to the simpler cases.

Conclusion

The work during the past year has become better organized, and the emphasis on some of the problems has changed since the program was initiated. This has resulted from more careful evaluation of the need for and interest in various parts of the work program by industry than could be obtained at the start. Through informal discussions with various technical groups, individuals, and representatives of industry, the Bureau technologists working on the assignments feel that with minimum effort and delay they have obtained a cross-sectional view of the efficacy of the program of secondary recovery to meet present needs and to build for the future.

ACKNOWLEDGMENT

Other contributors to Information Circular 7551 were H. C. Fowler, Petroleum Experiment Station, Bartlesville, Okla.; H. P. Rue, Petroleum and Oil Shale Experiment Station, Laramie, Wyo.; C. W. Seibel, Bureau of Mines Helium Plants, Amarillo, Texas; H. C. Miller, Petroleum Field Office, San Francisco; C. B. Carpenter, Petroleum Field Office, Dallas; and S. S. Taylor, Petroleum Field Office, Franklin, Penn.

REFERENCES

[5] Report of Advisory Committee on Secondary Recovery of the Interstate Oil Compact Commission in connection with Bureau of Mines Secondary Recovery Research activities, Sept. 1949.

[6] Watkins, J. Wade, "Corrosion and Chemical Treatment of Waters for Subsurface Injection," *Producers Monthly*, Feb., March, Apr., 1950 Watkins, J. Wade, Arthur, C. E., Willett Jr., F. R., "Field and Laboratory Studies of Methods of conditioning Water for Subsurface Injection," American Chemical Society, Houston, March 27, 1950.

[7] Grandone, Peter, and Holleyman, J. B., "Injection Rates and Pressures for Water Flooding Mid-Continent Oil Sands"; Bureau of Mines Rept. of Investigations 4600. 1949, 30 pp.

[8] Taliaferro, D. B., and Hamontre, H. C., "A Stuffing Box for Armored Electric Cables," *Oil & Gas Journal*, Vol. 47, No. 32, Dec. 9, 1948, pp. 105-108.

[9] Bossler, D. P., and Grant, Bruce F., "Field Experiments with Intermittent Water Injection Into Gas-Injection Wells on Secondary-Recovery Projects"; Twelfth Technical Conference on Petroleum Production of School of Mineral Industries, Pennsylvania State College, State College, Pa., Oct. 14-16, 1948.

[10] Dodd, C. G., Davis, J. W., Pidgeon, Francis, "Measurement of Specific Surface Areas of Nonporous Powders by a Pressure Decline Liquid Permeability Method," 116th Annual Meeting, American Chemical Society, Atlantic City, N. J., Sept. 20, 1949.

[11] Denekas, M. O., Carlson, F. T., Moore, J. W., Dodd, C. G., "Isolation and Analysis of Material Adsorbed at Crude Petroleum Water Interfaces, I. Normal Paraffins of High Molecular Weights," American Chemical Society, Houston, March 27, 1950.

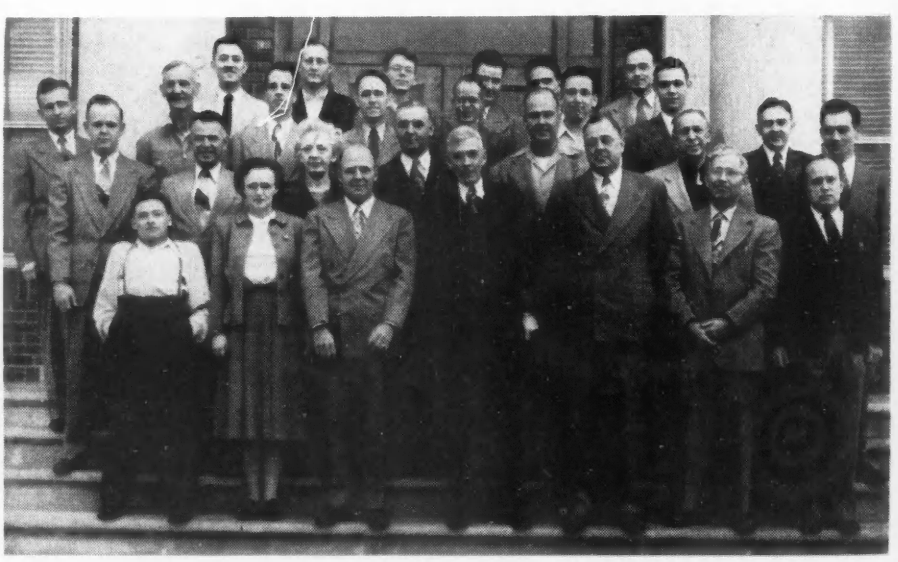
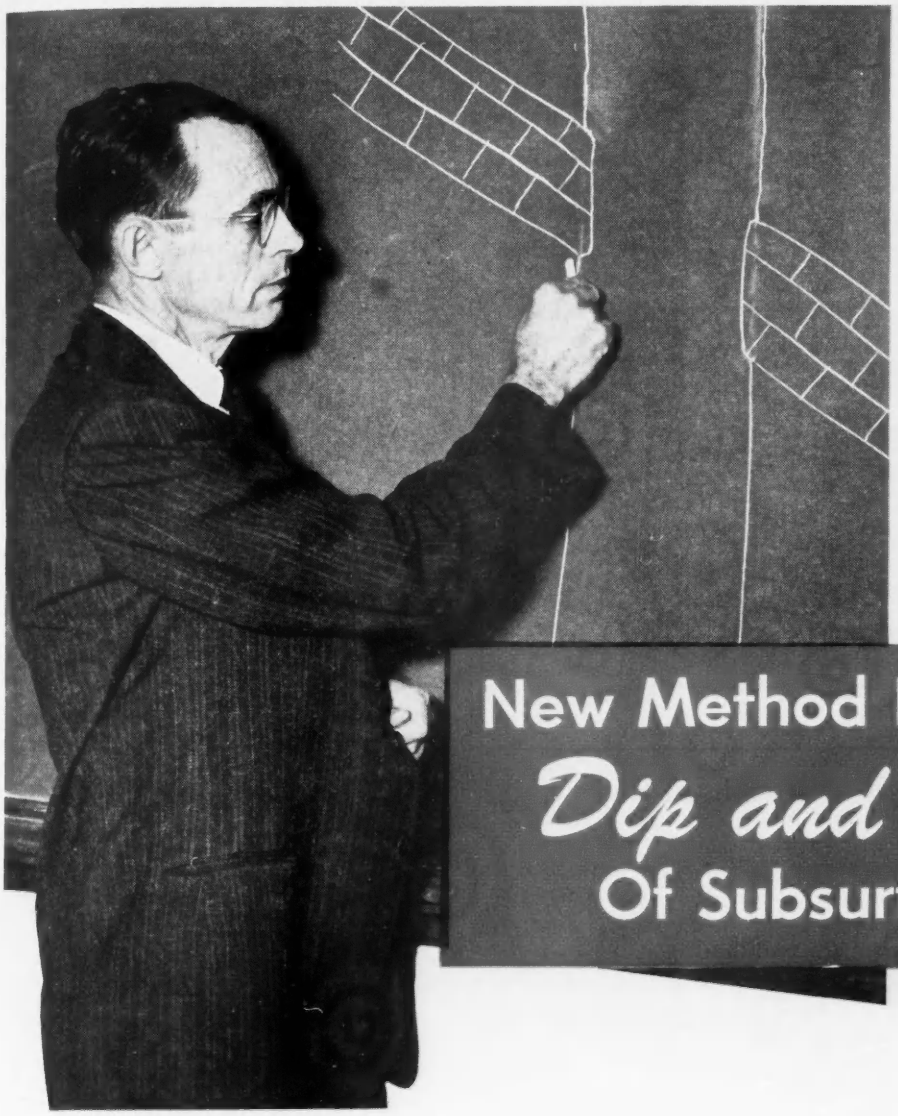


FIGURE 6. In charge of secondary recovery oil research at the Petroleum Experiment Station, U. S. Bureau of Mines, Bartlesville, Okla., are, left to right, back row: Franz T. Carlson, John C. Joers, Philip B. Lorenz, Paul Meadows, Hugh C. Hamontre and Charles G. Dodd; second row from rear: J. W. Watkins, Leonard Johnson, John P. Powell, James W. Davis, F. R. Willett, Jr., W. L. Martin, Herman J. Ledbetter; third row from rear: J. A. West, Jack Wright, Mrs. Cleo G. Rall, C. H. Riggs, J. W. Moore, C. R. Bopp, James D. Polston, John D. Wey; front row: Charles E. Arthur, Frances D. Pidgeon, Kenneth H. Johnston, H. C. Fowler, D. B. Taliaferro, Peter Grandone and F. E. Armstrong.



F. G. Boucher, head of the Development Engineering section at The Carter Oil Company laboratory, advanced the idea that dip of formations could be recorded by measuring erosion in well bores. Here he demonstrates formation dip which can be plotted from information obtained by dip-logging.

New Method Logs *Dip and Strike* Of Subsurface Formations

THROUGH USE of a new tool, the dip and strike of subsurface formations encountered in a drilling well may be determined. If a wildcat proves to be a dry hole, the instrument can indicate the most favorable direction to locate another test higher on structure. If the wildcat is productive, it can point out the most favorable direction to develop the pool.

A NEW tool designed to determine the dip and strike of subsurface formations in a drilling well has been perfected by research engineers at The Carter Oil Company laboratories in Tulsa. Known as the Dip-Logger, the tool has undergone extensive and successful field tests. Its application is based on the fact that the drilling process erodes some formations more than others, thus making it possible to take measurements of the vertical displacements of the edges of the hard strata protruding into the well bore. From these measurements and from continuous measurements of inclination and direction, the dip and strike of the formation can be calculated.

To the wildcatter who drills a dry hole, the Dip-Logger can indicate the most favorable direction to locate a second test higher on structure. If a wildcat is successful, the instrument can indicate the most favorable direction to stake the offset and to develop the pool.

Anyone who has observed a weathered outcrop has noticed that the bedding shows in relief. The same condition exists along the walls of a bore hole as exists on an exposed outcrop; that is, formations resistant to erosion stand out as ledges in contrast to those that are less resistant (Figure 1). If a continuous profile is made of the wall of a bore hole in three or more azimuths simultaneously, a record is obtained on which formations resistant to mud erosion appear as peaks or mesas, and formations subject to erosions as valleys.

To determine the dip of a formation it is first necessary to establish at least three points on its surface. This is accomplished by reproducing three separate profiles of the wall of the bore hole, each profile being removed from the other two by 120 degrees of azimuth. These profiles are recorded simultaneously on a log having a vertical scale which is greatly expanded compared with scales normally used for profile logs. Such an expanded scale permits the profiles of the ledges and recesses to be recorded in almost their true proportions and enables any ledge to be identified on all three profile traces. After a ledge has been identified on all three traces,

it is possible to pick a point on each of the traces which represents the top inside corner of the ledge. These three "pick points" are considered to be in the plane of the subsurface formation.

After establishing three points in the plane of the formation, the second step is to determine the relative positions of these three points. This is done by direct measurement from the log. Both the horizontal and vertical scales of the log are known, and the expanded vertical scale makes possible the measurement of very small vertical displacements, on the order of one-fourth inch in the bore hole. (In a nine-inch hole, 0.16-inch vertical displacement corresponds with one degree dip.) By using these measurements the position of each of the three points can be determined relative to a common vertical center line and relative to a common horizontal datum. (This assumes a vertical hole.)

A mechanical computer has been devised to relate these measurements and reproduce a plane having an attitude corresponding with that of the subsurface formation. Thus, the dip of the subsurface formation is readily determined by measuring the dip indicated by the plane of the mechanical computer.

It is also necessary that the equipment record data from which the azimuth of one of the profile traces can be obtained in order that the direction of downdip can be determined.

In the event the bore hole is not vertical, the dip must be corrected for the inclination of the bore hole to obtain the dip relative to the horizontal. For this reason the equipment records data from which the magnitude and direction of the hole inclination are obtained. Figure 2 shows a sample log recorded by the present dip-indicator equipment operating on the basis of the method outlined. The respective traces are identified on this sample log and the 11 measurements necessary for a single dip computation are indicated.

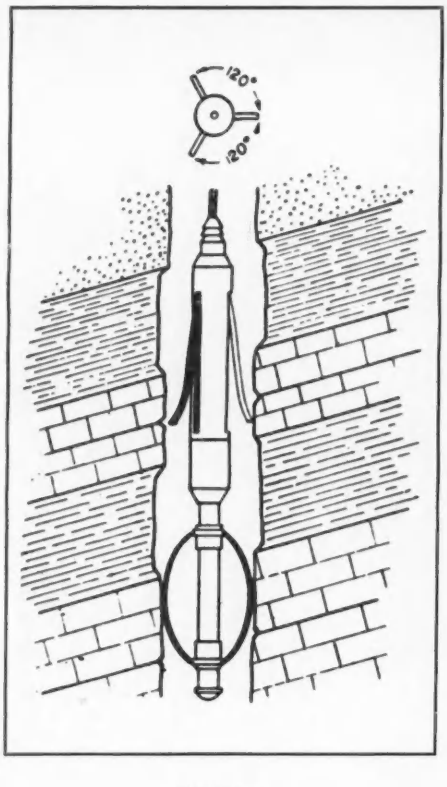


FIGURE 1

Subsurface Equipment

The dip-indicator probe and its two centralizing devices constitute the subsurface part of this apparatus. Except for the measurement of depth, the probe makes all the initial measurements required for the computation of dip.

Physically, the probe (with profiling arms retracted) has a maximum diameter of 4½ inches, weighs about 350 pounds, and for transportation purposes is 11 feet long. When operating in a well, the bottom centralizer increases the total length of the probe to 15 feet.

The top section of the probe contains the three profiling mechanisms which send information to the surface from which a record of the three profiles of the bore-hole wall is made. Each profiling mechanism essentially is composed of a profiling arm and a profiling coil. The arms are spring-loaded so that the hardened tips at the lower end of each arm are held constantly against the bore-hole wall as the probe is pulled up the hole. The spring tension is sufficient to cause the pointed arm tips to cut through the filter-cake of mud and to follow the true eroded profile of the bore-hole wall. This in-and-out motion of the arms, as they follow the irregular wall profile, is transmitted mechanically to moveable iron cores in the profiling coils. Movement of the iron cores in the profiling coils causes electrical changes which are modified and recorded by surface equipment. As finally recorded on the log, these electrical changes give a graph of bore-hole radius versus hole depth for each profiling arm. Such a graph is commonly called a "profile" of the bore hole. The profiling mechanisms are capable of measuring the profiles of bore holes up to 30 inches in diameter.

The midsection of the probe contains a device for locking the arms into the probe. The log made with this equipment is obtained by pulling the probe from the bottom of the uncased hole to the top. Hence it is necessary to lock the arms in the probe during the time when the probe is being lowered into the hole. The arms are then released at the lowest depth for which a log is desired. This locking device is cocked manually before the probe is lowered into the hole. The arms are released, when the operator desires, by electrical means.

The lower section of the probe houses the orientation unit, which contains devices to measure the orientation of the probe relative to compass north and to the vertical. The direction-measuring apparatus includes an oil-damped magnetic compass assembly and a "lubber's line" or reference-point electrical contact located on the circumference of the probe section. A light bulb and a photocell are driven mechanically around the periphery of the compass, and are so arranged that the photocell receives a light flash each time it passes mirrors attached to the north, east, and west points of the compass needle. The resultant pulses are recorded as Trace 5 of Figure 2. (The east and west pulses

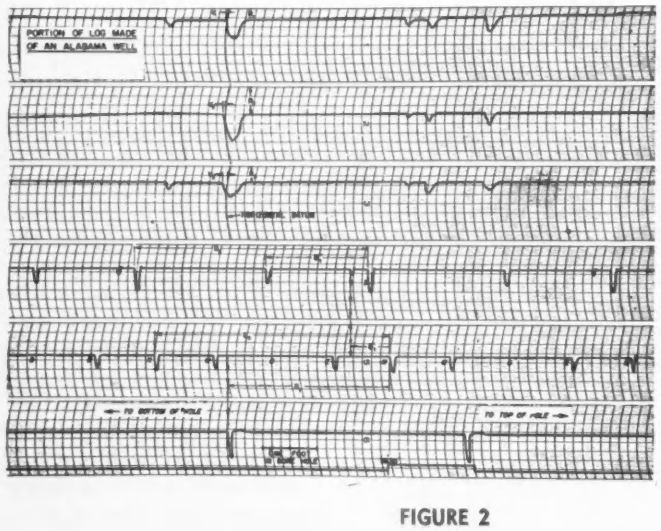

PORTION OF LOG MADE OF AN ALABAMA WELL
Vertical Datum Profile Trace No. 1
Vertical Datum Profile Trace No. 2
Vertical Datum Profile Trace No. 3
Inclinometer Trace
Compass Trace
Lubber's Line Trace
Depth Marker Trace (Marker Occurs Every 10')

FIGURE 2

TRU-LAY
Preformed
WIRE ROPE

Available through Distributors
All Around America

TRU-LAY

Performs Better—Handles Easier
Reduces Accidents—Lasts Longer

IT'S MADE
"Intentionally Better"

ACCO

Wilkes-Barre, Pa., Atlanta, Chicago, Denver, Houston, Los Angeles,
New York, Odessa, Tex., Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

AMERICAN CHAIN & CABLE
AMERICAN CABLE DIVISION

TRADE MARK

In Business for Your Safety

Tru-Lay *Preformed* **Wire Rope**

are recorded only for instrumental reasons, and need not be considered here.) The lubber's line contact is also recorded as a pulse (Figure 2, Trace 6). The interval between the "North" compass pulse and the lubber's line pulse then represents the angle between the index mark and north, and thus gives the orientation of the probe with respect to compass north. The scanning light rotates about seven times a minute, which at normal logging speed amounts to a reading every seven feet of hole. Since little or no change in orientation occurs as the 15-foot probe traverses seven fet of hole, these values are effectively a continuous record of orientation.

The inclination orientation device embodies a unique double-pendulum arrangement operating in a heavy viscous fluid which damps out undesirable pendulum oscillations. One pendulum determines the direction of probe inclination; the other measures the magnitude of probe inclination. A mechanical system is used to amplify the indications of the magnitude-measuring pendulum by a factor of ten in order to obtain accurate measurements of small probe inclinations. The probe inclinometer is adjusted to measure hole inclinations ranging from zero to ten degrees. The inclinometer indications are changed to electrical signals by the same type of scanning system used to obtain compass direction.

The orientation unit contains various other components, the most important of these being the spring motor. This motor supplies the mechanical energy required to run the scanning device and stores enough energy to log 20,000 feet of hole. The energy for the lights in the optical systems is furnished by three special long-life flashlight batteries which will operate successfully up to bottom-hole temperatures of 270° F. By means of a relay, the scanning device and the lights in the optical systems can be turned on or off by the operator at the surface.

The centralizing devices constitute the remaining important components of the probe. A centralizer is placed at the top and bottom ends of the probe in order that the centerline of the probe will coincide with the centerline of the bore hole.

The electronic equipment associated with the dip indicator consists of three amplifier panels and two power supply panels. This equipment allows six signals to be transmitted continuously on the three conductor well-logging cable and at various times during the logging operation any one of three

Boucher and A. B. Hildebrandt, research engineer, examine metal recording arms of the dip-logger.

additional signals is also transmitted by the cable. The electronic equipment also changes the signals from the well-logging cable into a form suitable for recording.

The recording equipment used with the dip indicator consists of a modified six-channel Brush oscillograph. The six-channel recorder has been modified to record seven traces instead of six for which it was designed and these traces are recorded on a continuous log which has a maximum length of 800 feet. Such a log allows 8000 feet of open hole to be logged at an expanded scale in which one inch of the log equals ten inches in the hole. The recorder has a usable frequency response up to 100 cycles per second and allows the record to be seen as it is recorded. Likely pick points can be noted in sections of the hole where dips are most desired by the operating people.

The paper motor in the recorder is driven by a selsyn transmitter, which in turn is driven by the measuring sheave at the well-head. Thus the speed of the record through the recorder is directly proportional to the logging speed. Depth dips are automatically recorded at ten-foot intervals on the log as a byproduct of the selsyn system which drives the paper motor. A sample record as made by the modified six-channel recorder is shown in Figure 2.

Computing Equipment

Inasmuch as the computing equipment is essential to the final determination of dip, it is here described. A portable viewing table allows 24 inches of the log to be viewed at a time as the log is rolled from a full spool at one end of the table to an empty spool at the other end. The two spools are fitted with cranks which are manually operated to expose the desired part of the log. It is very convenient to have two viewing tables if repeat logs of the same well are to be compared.

A mechanical computer is used to facilitate the determination of dip relative to the bore hole. The computer provides three scales, the indices of which are set according to the respective radii of the pick points as measured on the log. Three additional scales are equipped with indices which are set according to the respective vertical displacements of the three pick points as measured on the log. A compass rose is provided into which the direction of arm No. 1 is indexed. The setting of these indices positions the pointed tips of three rods in the same position relative to each other, and relative to compass rose north, as was possessed by the three pick points in the bore-hole wall. The computer is equipped with a metal plate which can be caused to rest on all three points. When this is accomplished, the magnitude and direction of downdip, relative to the bore hole, can be read from scales provided for this purpose. The dip magnitude scale is graduated in one-degree intervals; the dip direction scale is graduated in five-degree intervals. The computer was designed to compute dips up to 60 degrees and to accommodate data from holes up to 30 inches in diameter.

A nomograph is used to convert distances measured on the log into angles which can be used directly in the computing process. In order to obtain inclination and direction data, five representative distances are measured from the proper traces on the log. Entering the nomograph with one pair of these distances at a time, the operator can obtain successively angles representing: (1) the direction of profiling arm No. 1; (2) the direction of hole inclination; and (3) the magnitude of hole inclination.

A Polar Chart is used to convert the dip relative to the bore hole into dip relative to horizontal, which is the true dip.

All the computing equipment is designed so it can be taken to the field with the remainder of the dip-indicator equipment. As a result, dips can be computed in the field immediately after the log is obtained if desired.

ACKNOWLEDGMENT

The description of the instrument and the method of operation is taken from Vol. 34, No. 10, Bulletin of the American Association of Petroleum Geologists, October, 1950, with permission of AAPG and The Carter Oil Company. Work described was done by the Research Laboratory of The Carter Oil Company under contract with The Standard Oil Development Company.

Smooth POWER... U-30

FOR DEEPEST WELL DRILLING

The U-30, with its simplified controls, precision construction, and ease of operation gives you smooth, controlled power, even when you're down ten, twelve, fifteen, or twenty thousand feet. Any combination of engines in multiples of two, three, four, five or six developing a maximum of 1,650 H.P. is recommended. Investigate the U-30 and learn how this smooth power rig can actually lower deep well drilling costs.

Write for Information.

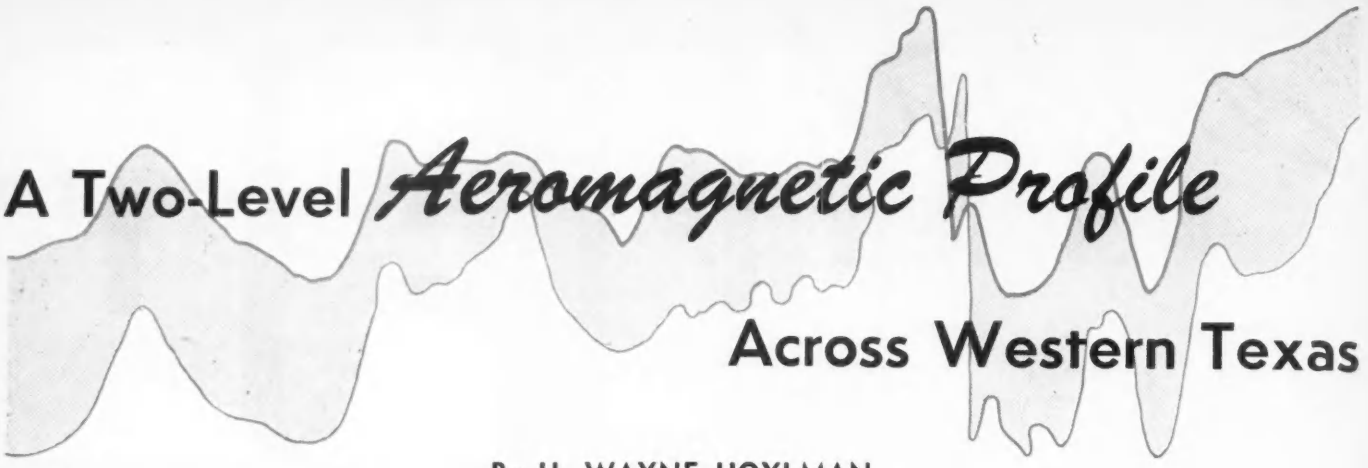
UNIT RIG & EQUIPMENT CO.
TULSA, OKLAHOMA U.S.A.

DESIGNED FOR THE JOB....

Exclusive Export Representative
MID-CONTINENT SUPPLY CO
42 Broadway, New York City
Cable Address: MIDUNITRIG

50-B

A Two-Level *Aeromagnetic Profile* Across Western Texas



By H. WAYNE HOYLMAN

Geophysical Consultant, Los Angeles

INTRUSIVE AND EXTRUSIVE igneous flows play an important part in structure building and sedimentation. Where extrusives occur on the surface, they mask the underlying sedimentary conditions and today the petroleum geologist is interested in not only the thickness of the extrusive flow but the thickness of the sediments between that flow and the basement complex. The use of the airborne magnetometer, by multi-level surveying, offers a fairly accurate and economical method for solving this general type of geological problem. The single two-level profile, as described in this article, shows the ease by which the magnetic influence of the extrusive is separated from that of the basement complex and from the respective curve it appears that a plausible interpretation of this complex double-layer problem of extrusives and intrusives is possible.

IN PORTIONS of many sedimentary basins where petroleum exists, extrusive flows occur and the pressing problem is to determine something about the sedimentary section beneath the flow as well as the thickness of the extrusive layer. The most obvious geophysical instrument that can produce data for the possible solution of this geological problem is the airborne magnetometer. Obviously, where thin igneous flow occurs at a considerable distance (many times their thickness) above the basement complex it should be theoretically possible to observe the earth's magnetic field at sufficient height that the magnetic intensity or magnetization of the flow is non-existent. The intensity observed at such a level would, for practical purposes, be due to the magnetization of the basement complex underlying the flow. By a carefully planned system of multi-level flying it should be possible to determine the following:

- The average depth to the basement beneath the survey level and hence the thickness of the sediments.
- Average thickness of the flow.

Because of the extrusives in the Davis Mountains south of the Delaware Basin, a careful study was made of the geology in the southwestern part of West Texas and it became apparent that a single reconnaissance type of airborne magnetometer profile flown at a minimum of two levels might supply actual field data which would either substantiate or refute, at least, a part of the theoretical aspects of the problem. Furthermore, it seemed advisable to extend this two-level flight beyond the lava flows across the Marathon Uplift to the southeast and to the northwest across the Hueco Basin so that additional data would be obtained and thereby permit a study of a two-level profile where no flows exist.

Because of these objective possibilities, in March, 1949, Fairchild Aerial Surveys, Inc., Airborne Magnetometer Division, flew a two-level airborne magnetometer reconnaissance profile southeast from El Paso, a distance of approximately 300 miles, to the vicinity of Sanderson, Texas, near the Rio Grande, longitude 102 degrees west. The geographical position of this profile is shown on the sketch map in the upper right hand corner of Figure 1.

The Gulf type of magnetometer was used to observe the earth's total magnetic intensity at 8000 and 12,000 feet, respectively, above sea-level. They flew, as nearly as was humanly possible, the same course over the surface of the ground. At the higher elevation, however, lateral variation may occur which is difficult to detect except by photographic means. This is especially true at points where changes in headings of 30 degrees or more take place. Actually, southeast of El Paso at 110 miles and 215 miles, respectively, such changes in headings occurred and there are discrepancies in the magnetic curves indicating the trace of the profile over the surface of the ground is not identical. In order to get a record of the respective flight paths of the profiles a 35 millimeter camera was operated and photographed the ground directly beneath the aircraft. With the exception of places where turns occurred, the photography showed that the two profiles are, for practical purposes, identical.

Construction of the Plate

In the upper portion of Figure 1 is shown two aeromagnetic curves with the regional gradient removed. Beneath them is a cross section of the surface topography along the trace of the profile over the surface of the ground. At the bottom of the plate there is a strip map showing the surface geology along the flight path of the profile. The zero point of the profile is at the El Paso Airport with the distance in miles increasing to the

southeast or from left to right.

From the theory of the earth's magnetization of various types of igneous rock along with their areal extent the vertical distribution in the crust of the earth, it is reasonable to assume that in those places where broad gentle type anomalies and magnetic features cover a number of miles along a profile, they are in general a reflection of igneous rock comprising the basement complex, and furthermore, they are a considerable distance below the survey level of the profile. Actually, such anomalies and magnetic features when flown at a second level, only 4000 feet higher, would have much the same expression as displayed in the lower level.

In areas where sharp anomalies and features exist at only a few miles along a profile, they reflect igneous rock that may be either intrusive or extrusive in type and which may or may not have a vertical thickness sufficiently in proportion to the 4000-foot variation in the survey levels to produce an anomaly or feature at the higher level that bears any relation to its counterpart in the lower level. Actually, where volcanic flows exist as surface outcrops and these areas where large magnetic differences occur along a profile at two levels, it is reasonable to interpret the difference as due to the igneous material being very thin in vertical dimension and the anomalies, therefore, related to the flows have attenuation at the higher level. Therefore, a single two-level profile may supply magnetic data having a bearing on the possible variation in the depth to the basement complex as well as indicating where thick and thin vertical sections of extrusive flows exist along the profile. It is with such theoretical conditions in mind that the anomalies and features as shown along the two-level profile on the accompanying plate are examined.

Magnetic Feature

It is to be noted that 15 geographical positions are indicated along this profile. Position 1, at the left hand end of Figure 1, shows a strong magnetic feature in vertical relief as well as large in areal extent. Because of the similarity of the two magnetic curves at the respective levels, it is reasonable to interpret the two levels as reflecting the basement located at considerable distance below the flight level. From the shapes of the curves it is anticipated that this is a batholitic type of intrusion in the basement complex which has considerably more vertical dimension in the inter-basement.

To the right, along the profile, are geographical Positions 2 and 5 which mark the flanks of another type of basement intrusion which approaches a laccolith rather than batholith or the igneous rock is not as great or, at least, the magnetization of the basement is not as great as in Position 1. This less deep-seated type of basement intrusion occurs in the area of the Quitman Mountains. Superimposed upon this second type of basement mass we have two magnetic features indicated at geographical Positions 3 and 4. At Position 3 is an anomaly of moderate relief. In as much as it has the same appearance in both profiles, it is reasonable to assume that it reflects an intrusive type of igneous mass which has considerable vertical thickness. In looking at the surface geology in the vicinity of Anomaly 3, it is to be noted that no igneous outcrops occur; however, to the northeast there is an intrusive mass and consequently it is suspected that this mass continues to a position beneath the profile and is relatively close to the surface.

At geographical Position 4 is a considerable variation in the magnetic feature at the two respective levels. The attentuation of the anomaly at the higher level indicates that the magnetization of the rocks giving rise to this magnetic feature must be rather thin in vertical dimension. Here is the first evidence of an igneous mass of apparently thin vertical dimension because a 4000-foot change in flight level produces a tremendous decrease in intensity at the higher level. From the extent of this anomaly

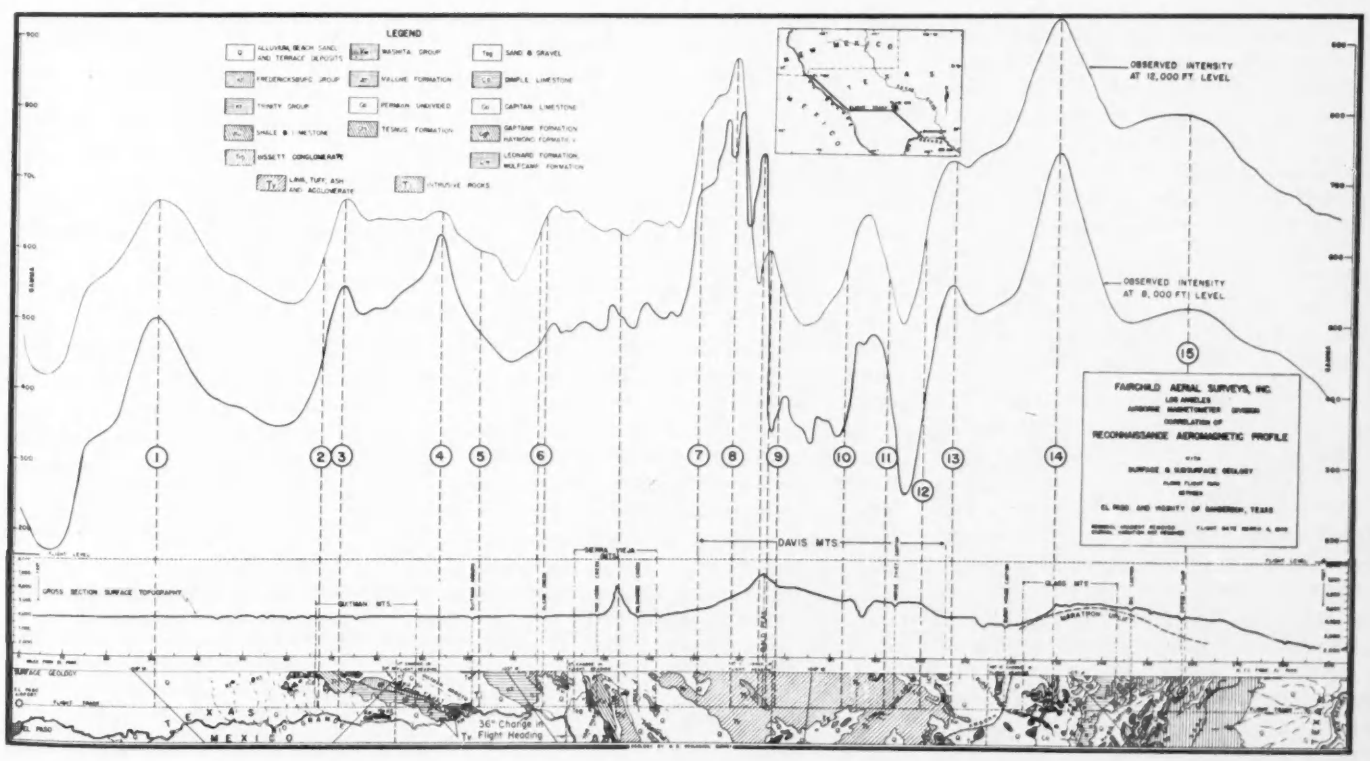


FIGURE 1

along the profile, there must be a considerably larger area of extrusives along the profile than is shown by the three small surface exposures in the vicinity of the regional fault.

Between Positions 6 and 7 there occurs, for the first time, numerous small sharp anomalies which imply variable conditions in the igneous rock only a short distance below the 8000-foot level. At only two places are extrusives shown as outcrops between No. 6 and No. 7, but there must be a rather extensive areal extent of them between the alluvium. At the higher level there is a marked decrease in intensity but the anomalies have the same general shape which implies either moderately thick flow or an intrusive mass.

At Position 7, a continuous outcrop of volcanics starts and in addition the surface topography begins to increase in altitude. This is in the immediate vicinity of the Davis Mountains. Between Positions 7 and 9 is shown considerable variation of the intensity at the lower level with the higher level showing only the regional magnetic feature. The sharp anomalies on the lower profile are therefore interrupted as being related to the volcanics on the surface and that the larger magnetic feature, so apparent on the upper level, is reflecting an intrusive mass of thick vertical dimension as compared to flows, presumably, only hundreds of feet thick. In this area we definitely have a two-layer type of magnetic problem, one coming from the extrusives, the other from the intrusives.

The section of the magnetic profiles between Positions 9 and 10 is magnetically low. However, at the lower level the intensity from the extrusives produces sharp anomalies which are missing at the higher level. It is interesting that in areas of even low magnetic relief, as presumably related to basement rocks, the magnetization of the extrusives is not more apparent at the higher level. This is strong even for a thin layer of extrusives in this part of the Davis Mountains.

It is to be noted that there is a magnetic feature between Positions 10 and 11 that is quite similar at both levels with some sharper anomalies at the lower level reflecting some influence from volcanics while the upper level is the type of feature that is indicative of igneous rock in the basement complex and which has considerable vertical thickness in the basement. Here again a definite indication of a two-layer condition of igneous masses with the more important one reflecting basement conditions.

Between Positions 11 and 12 there is again a very sharp pronounced magnetic low which is presumably indicative of the predominating influence coming from the basement complex rather than the volcanics on the surface. At Position 12, the shape of the curve implies a fault in the basement which would have considerable throw that would be down to the left and up to the right. This may in part give rise to the low existing between No. 11 and No. 12, but the major portion of this feature is due to apparent changes in susceptibility of the rocks within the basement complex. The extrusives in this part of the profile have no magnetic influence at even the lower level. They must be quite thin in this area.

At Position 13 is a type of magnetic anomaly indicating some relationship to the basement complex because of its apparent similarity at the two levels. It is suspected that, again, in this area there may be a fault condition, with the down-thrown to the right and the up-thrown to the left. Actually, the trace of the fault would be two to three miles to the right of Position 13.

Position 14 is on the north flank of the Marathon Uplift and at the south tip of the Glass Mountains. Here again is a magnetic feature indicative of the intrusive type of basement rock. As a matter of fact, because of the similarity of the two curves, it is believed that the basement complex must lie at considerable distance below even the 8000-foot level. It seems worthy of note that the apex of the Marathon Uplift is located more on the flanks rather than associated with the crest of this magnetic feature.

At Position 15 is shown the most positive evidence of an anomaly reflecting possible basement topography that may be giving rise to a regional type of uplift comparable to the Marathon Uplift. Again in this area is a deeply buried basement as indicated by the similarity of the two anomalies at the respective levels. It is in this portion of the profile that additional magnetic work might reveal possible basement relief that would be quite influential in producing structural conditions in the overlying sediments where a considerable thickness of sedimentary rock should exist.

Conclusion

It is realized that in the case of a single profile, a number of interpretations can be made as to geological conditions that are reflected in the aeromagnetics, so that no final conclusion can be made. However, with a single two-level reconnaissance profile, interpretative speculation is less than would otherwise be the case with regards to the double layer problem of extrusives and intrusives which is the purpose of this experimental flight. The data at least indicates plausible geological conditions about which more could be learned were additional aeromagnetic surveying done.

Actually, to get as complete as possible an evaluation of the two types of igneous conditions such as occur in the Davis Mountains, it would be necessary to make a survey with closely spaced profiles and in addition do a certain amount of two-level flying. From such combined information it would be possible to calculate the most probable depth to the basement complex as well as the thickness of the extrusive. Furthermore, anomalies related to basement topography would be identifiable on a percentage basis.

ACKNOWLEDGMENT

The writer wishes to thank the executives of Fairchild Aerial Surveys, Inc., for their permission to publish these data. He also wishes to thank the employes of the Airborne Magnetometer Division of Fairchild Aerial Surveys, Inc., as well as employes in the organization who assisted in the preparation of this material.

About the Author

H. WAYNE HOYLMAN has been active in geophysical work for 20 years. For 18 years (1930-48) he was a member of the geophysical staff, Gulf Research and Development Company, specializing in interpretation of ground and airborne magnetics and seismic data. In 1948 he became chief geophysicist for Fairchild Aerial Surveys, Inc., Los Angeles, and directed Airborne Magnetometer Division. He resigned early in 1950 to become a geophysical consultant in Los Angeles, specializing in the coordination of geophysical and geological interpretations. He received his B.A. in geology in 1935 and his B.S. in petroleum engineering in 1936 from the University of Pittsburgh.

Measure any other pressure control equipment against the advantages of the

SHAFFER COMBINATION ROTATING BLOWOUT PREVENTER AND STRIPPER

There's only one way to fully appreciate the unequalled pressure protection you get in the Shaffer Combination Rotating Blowout Preventer and Stripper . . . that's to measure—point-by-point—*any other* equipment on the market against the unique operating features incorporated into this unusually effective unit. For example . . .

MEASURE FOOL-PROOF DEPENDABILITY!

The Shaffer Combination Rotating Blowout Preventer and Stripper maintains its leak-proof seal *continuously* while pipe is in the hole. There is nothing to *operate*, nothing to *remember*, nothing to *forget*, when sudden pressure emergencies occur. The unit is *always* sealed off around the drill string, ready for instant protection against pressure blowouts!

MEASURE ALL-AROUND ADAPTABILITY!

The Stripper Rubber seals off around *any shape or diameter* in the drill string (excepting such abnormally large diameters as the bit and reamer). Automatic expansion and contraction accommodates any type of kelly—square, hexagonal or octagonal—as well as couplings, tool joints, subs, drill collars and pipe, whether flush, coupled or upset. *No special equipment or special pipe is needed with this unit!*

MEASURE TROUBLE-FREE OPERATION!

Since the Stripper Rubber rotates *with* the kelly—not around it—there is virtually no wear on the rubber. Patented steel reinforcing latches provide an expandable steel barrier that prevents extrusion of the Stripper Rubber either by high pressures or by pulling large diameters through it—yet maximum elasticity of the rubber is maintained. In addition, the bearing assembly upon which the unit rotates has separate thrust and radial bearings to withstand the severe loads occasioned by modern drilling practices . . . and the bearings are lifetime prepacked with heat-resisting lubricant. Maintenance is negligible!

MEASURE OPERATING SIMPLICITY!

When the drill string is in the hole, adjustment to different diameters and shapes in the string is *completely automatic*—no manual operations are necessary. When running large tools such as bits or reamers through the unit, simply pull a spring latch, rotate the bonnet 1/6 turn and the entire internal mechanism as a unit can be withdrawn to permit removal of the tools. Simply reverse the operation when going back into the hole.

MEASURE SPACE-SAVING COMPACTNESS!

The Shaffer Combination Rotating Blowout Preventer and Stripper is so engineered that vertical height in the drilling riser is kept at a minimum. It can be installed even under the most difficult space limitations. Moreover, flow connections built directly into the body eliminate need for spools or other equipment for overflow connections.

These and other unique advantages of the Shaffer Combination Rotating Blowout Preventer and Stripper—plus the *quality* that is built into every part—make it the most *efficient*, most *versatile*, most *practical* pressure control unit yet developed. Investigate and compare it with *anything else* on the market!

Write for complete details on the Shaffer Combination Rotating Blowout Preventer and Stripper—or see your nearby Shaffer representative.

Send for your free copy of the new Shaffer Catalog. See pages 4433 to 4496 of your 1950 Composite Catalog for helpful data on the complete Shaffer line of field-proven products!

27 years OF OIL TOOL LEADERSHIP

SHAFFER

HIGH PRESSURE DRILLING AND CONTROL EQUIPMENT • FISHING TOOLS THAT EXCEL

SHAFFER TOOL WORKS, Brea, California • California Service Shops: Santa Fe Springs and Taft
HOUSTON, TEXAS, 6006 Navigation Blvd. • ODESSA, TEXAS, 1925 West Second Street
OKLAHOMA CITY, OKLAHOMA, Acme Oil Tool Company, 1001 S. E. 29th Street
CASPER, WYOMING, Shaffer Tool Works, Post Office Box 1788
EXPORT SALES OFFICE: Shaffer Tool Works, 500 Fifth Avenue, New York, N. Y., U.S.A.

Petroleum Geology Pioneered in Tennessee

TENNESSEE'S FIRST state geologist, Gerard Troost, born and educated in Holland, is due honor as prophet of petroleum geology and paleontology. Having previously observed Pennsylvania oil springs and then studied Tennessee oil seeps 27 years before Drake well, he was pioneer in recognizing probable organic origin of petroleum. Ironically, the state which gave the petroleum industry this prophet so far has had only minor production of oil and gas. But Tennessee does offer petroleum possibilities, and may yet provide production appropriately honoring its prophetic first state geologist.

Photo shows fractures or fissures, the result of a great natural explosion (assumably gas pressure) in dry limestone creek bed 13 miles northeast of Lebanon, Tenn.

AMONG the early scientific pioneers of petroleum geology and paleontology meriting high recognition, was Gerard Troost, first geologist of the state of Tennessee. Before he died 100 years ago, a decade before the Drake well in Pennsylvania, the Holland-born scientist had studied oil and gas seeps in both Pennsylvania and Tennessee and was one of the first, if not the first, to regard petroleum as being of organic origin. He saw great significance in the salt water and fossiliferous marine shells associated with oil-bearing rocks, and was a prophetic "bugologist."

Tribute to the valuable pioneering work of Troost in geology and paleontology was paid recently in an article in the newspaper, *The Lebanon Democrat,* Lebanon, Tenn., written by F. J. Sanders of Lebanon, formerly engaged in work in the mining industry in California.

Searching the archives of Tennessee's Division of Geology, Sanders explained in a letter to WORLD OIL, he secured information about Troost, "who died exactly 100 years ago, after making the first discovery of oil in Tennessee, 27 years prior to Drake's commercial discovery at Titusville, Penn. It was this old Dutchman who gave the world the true origin of oil as being of organic matter (vegetable and animal marine life) and not mineral as was the accepted theory at that period." (Oil seeps were noted by Troost in Tennessee about 1832, although the state's first commercial oil was found along Spring Creek in southern Overton County in 1866, seven years after Drake's discovery in Pennsylvania.)

Troost was born in Holland in 1775 and received his education at the universities of Leyden and Amsterdam, according to Sanders.

"Troost came to America," he continued, "and in 1812 was one of the founders of the American Academy of Natural Sciences in Philadelphia and for five years was its president. He came to Nashville in 1827 and was appointed to the chair of geology at the University of Nashville. It was Professor Troost who first located Tennessee's coal beds and recognized the beauty, quality, and value of Hawkins County marble. He also discovered the high grade slate in Sevier County and the east Tennessee zinc deposits.

"In an address before the legislature in 1831 he convinced its members that the state was a rich unexplored territory and was soon appointed Tennessee's first geologist. While investigating the state's coal beds on the eastern slope of the Highland Rim, Professor Troost noted the presence of oil seeps, which was the first discovery of petroleum in Tennessee. This discovery was made approximately 117 years ago, or about 27 years prior to Colonel Drake's commercial discovery in Pennsylvania. This black obnoxious fluid (used by the Indians for medicine) was then known as petroleum or rock oil, as the name suggests, being considered by the scientists of that period as of mineral origin due to chemical action on deep-seated strata.

"While doing research work at the academy in Philadelphia, Professor Troost had become especially interested in the 'burning springs' of black oil in Pennsylvania. A few years later when he made the discovery of oil in Tennessee, it occurred to him that oil showings in Pennsylvania and Tennessee were intimately linked, inasmuch as shallow hand-dug wells in both cases showed traces of oil associated with brackish or salt water, as well as fossiliferous marine shells, a subject on which he later became an international authority.

"From these deductions he advanced the theory (now universally accepted) 'that petroleum was formed by a change of organic matter, but from a different kind of organic matter, and under different conditions.

A complete line of
quality petroleum products

GULF OIL CORPORATION • GULF REFINING COMPANY

Gulf Building, Pittsburgh, Pa.

SALES OFFICES – WAREHOUSES

Located in principal cities and towns throughout
Gulf's marketing territory

Land plants, in the presence of fresh water, form coal; while marine plants and lower animals, in the presence of salt water, form petroleum, it being observed that petroleum is often found in connection with salt.' Thus a great Tennessean, by choice and adoption, often referred to in his day as 'the old bugologist,' had unlocked the door to one of nature's most valuable treasures and had given the key to geologists to guide their future explorations.

"While Troost's original discovery of oil in Tennessee was on the Highland Rim, an ancient shore elevation surrounding the Central Basin, it was the acres of interesting marine shells from Wilson and Sumner Counties that intrigued him most. Here he collected thousands of specimens from this old limestone sea-bottom, many being new to the science of the day, which he listed in a treatise written in 1849 but refused publication by the state, which at that period was more interested in coal, iron, and copper than in Professor Troost's writings on 'bugology.' He was especially impressed with the fact that in the Cumberland River Valley of Wilson and Sumner Counties, certain characteristic marine fossil shells seemed most numerous at the apex of certain ridges, where the limestone strata sloped in opposite directions from a common plane, now termed an anticline axis or oil structure, which indicated fracturing and then a shoving up from the sea bed, from great internal pressure, thus producing cavities below that would some day be reservoirs of petroleum.

"In 1850 the office of the Department of Geology, which had been established for Professor Troost, was abolished by the state, and a few months later the old man died. His body has passed on, but thought defies time, and the electronic energy generated in the dynamic brain of this old Dutchman will some day penetrate pools of oil in Wilson and Sumner Counties."

Gas being flared is from a strike at 330 feet on Tuttle farm, near Bethpage, Sumner County, Tennessee, north of Lebanon.

Within recent years, said Sanders, numerous shallow wells drilled for domestic water, following the contour of a high ridge in Wilson County, have produced gas, which on being ignited flamed many feet in the air. Another well drilled for domestic water in the yard of Mrs. Hawks, three miles east of Lebanon, produces crude that operates a farm tractor, just as taken from the well. Across the Cumberland River in Sumner County, near the village of Bransford, he continued, two interesting gas strikes have occurred from shallow wells drilled with crude equipment. The most recent, in March, 1950, occurred on the farm of J. E. Tuttle, and produced a roar that could be heard for more than a mile, according to Sanders.

He also stated that within 13 miles of Lebanon there occurred several years ago two great explosions in the earth's crust, apparently involving natural gas. The explosions occurred on very hot days in early afternoon in July in solid limestone rock of two dry creek beds. In both instances, Sanders stated, crevices, cracks, or fissures were made for several hundred feet in the solid limestone creek beds and are visible today.

In Sumner County, on the northern Highland Rim, a few wells have produced small amounts of oil from dolomitic limestones of Silurian age at 200-250 feet, according to Tennessee's Division of Geology, Department of Conservation. Several counties away from Sumner, toward the east, are shallow oil and gas fields in Clay, Pickett, Overton, Fentress, and adjacent counties. Most of the state's petroleum development has been in that region. Through the years, around 1000 wells have been drilled for oil and gas in Tennessee and about 925,000 barrels of oil has been produced.

Possibilities for oil and gas in Tennessee were discussed comprehensively in an article in *The Oil Weekly*, predecessor of WORLD OIL, August 7, 1944, pages 54-58, by Kendall E. Born, then associate geologist, Department of Conservation, Division of Geology, Nashville, Tennessee. In WORLD OIL of May, 1948, pages 160-170, an article, "Oil and Gas Possibilities of Southwestern Tennessee," by Carl A. Moritz, gave a detailed discussion of the geology of the western part of the state, lying within the Mississippi embayment. In 1946 the Tennessee Division of Geology of the Department of Conservation, Nashville, in cooperation with the U. S. Geological Survey, announced the release of Oil and Gas Investigation Preliminary Chart No. 4, by Ray Bentall and Jack B. Collins. That chart, approximately 56 by 36 inches, was in two sheets and described the subsurface stratigraphy and structure of the pre-Trenton Ordovician and Upper Cambrian rocks in Central Tennessee.

Farm hand fuels tractor with high-quality crude oil just drawn from a well drilled 180 feet for domestic water, three miles east of Lebanon, Wilson County, Tennessee.

IS MUD!

Magcobar

Complete

DRILLING MUD SERVICE

Regional Study Reveals

Colorado Oil Prospects

By DR. CLARK F. BARB
Professor, Petroleum Engineering, Colorado School of Mines, Golden

COLORADO OFFERS possibilities of additional oil fields, which may be discovered through geophysical and geological work, deeper drilling, and more wildcatting. Although Lower Cretaceous fields are the most common, production is found in Colorado in formations ranging from the Tertiary to the Permian. In the Plains region east of the Rockies there has probably been much unjust condemnation of prospective areas, especially where water in the Dakota has stopped wells that might have found oil in lower horizons.

FROM the oil operator's viewpoint Colorado may be divided into three general areas: the Plains region east of the Rockies; the Western Slope, which is generally west of the mountainous area; the Mountain Parks area from North and Middle Parks down through South Park, and the San Luis Valley. This geographic division differs considerably from the geologic subdivision given by the American Society of Petroleum Geologists in a chapter on Colorado and adjoining states in its 1941 resume, published under the title: "Possible Future Oil Provinces of the U. S. and Canada." Readers are referred to this publication for an excellent general picture of the geology of the state.

Production in Colorado is found from the Tertiary to the Permian, but Lower Cretaceous fields are the most common. Mancos, Florence, Canon, Boulder, Tow Creek, and Rangely produce from shales above the Dakota; Greasewood, Wellington, Fort Collins, Price and Hamilton produce from the Dakota; and Hiawatha and Powder Wash from the Wasatch, which is of Tertiary age. Rangely produces also from the Weber or Tensleep.

Heaviest production now comes from the Weber (Pennsylvanian) sand of northwestern Colorado. Little production has been found below the Permian; although several tests have been drilled to the basement rocks in both the eastern and western parts of the state. A number of these tests penetrated Pennsylvanian and Mississippian formations. Numerous oil and gas shows have been reported, but no commercial production has yet been found except in the Rangely field and possibly in La Plata County.

While studying well logs and plotting locations of wildcats in the Plains region of eastern Colorado, the author observed a rather striking point. It has been noted that many wells have been abandoned just below the Dakota, where water was found (often with oil shows) in the Dakota and higher formations. It seems that this may have been an error in many places where productive zones could occur below the Dakota. Water in the Dakota does not necessarily imply that water would be found in the Permian, Pennsylvanian, or Mississippian, as these lower formations apparently do not have the continuity of permeable beds that is found in the Dakota series.

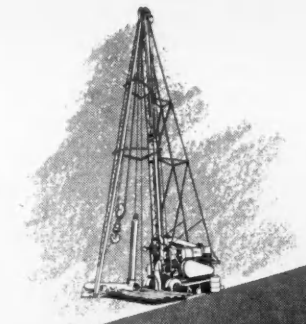
Unlikely Area

The Dakota formations, from Wyoming to New Mexico, are upturned against the flank of the Front Range, and every stream from the mountains flows over the outcrop. The formation is being continually saturated with fresh water, which naturally moves east along the regional dip and tends to flush the beds. The author feels that a Dakota field in this area will be exceptional, unless the closure is great enough to minimize this flushing action or unless there is trapping due to faulting or lensing. This is indicated by the fact that Wellington and Fort Collins, the only productive Dakota fields east of the range, have strong closures. The oil at Greasewood is apparently due to the lenticular condition of the Muddy sand.

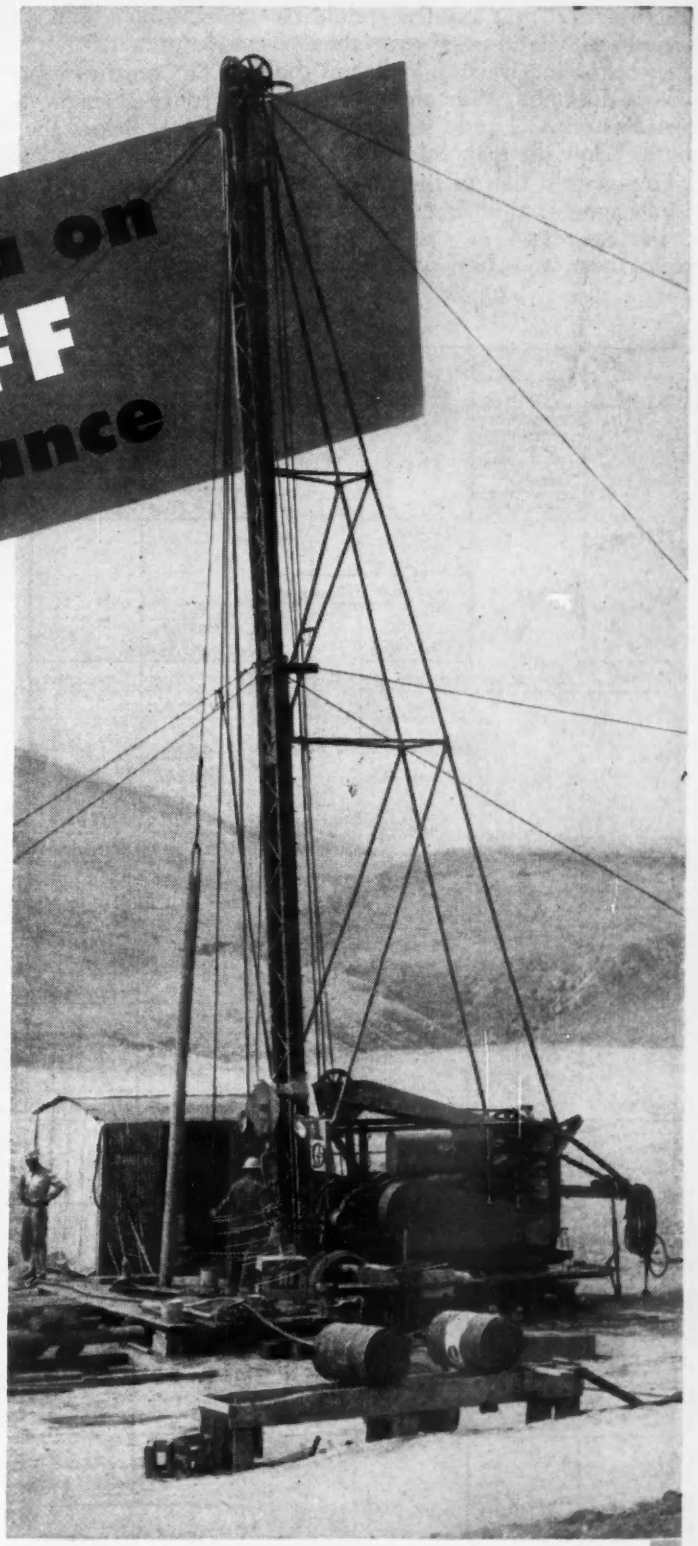
This flushing action probably can occur from the Front Range to the outcrops of the Dakota in Kansas and Nebraska. No strong structures are evident throughout this region beyond the local disturbances at the flank of the range. Dakota water for 300 miles east is commonly fresh or possibly brackish. There is every evidence of widespread flushing, but small local traps may be found. This flushing action may not be so probable in formations below the Dakota because of the lack of widespread continuous beds. There is every reason to believe that accumulation of oil may be found in the Permian or deeper horizons where the structure is favorable, even though the Dakota itself may carry water. This has been amply proved in the fields of western Kansas. Common practice is to shut off Dakota water when producing from lower zones.

It has been pointed out by geologists of this region that many of the test wells of the Plains region were drilled on misleading geologic evidence. For example, many wells were drilled on dips in members of the Pierre shale. It has since been realized that dips in the Pierre are not trustworthy evidence, because the Pierre is a thick series of incompetent beds. The present trend, therefore, is toward a greater use of geophysical methods to determine the presence of structural features in the lower Cretaceous or older formations.

The general conclusion of the author is that a great part of the Plains region has been unjustly condemned. It is felt that a test well should be on a geophysical as well as a geologic



Here's Data on PAYOFF Performance



In field after field, cable-tool men are realizing bigger profits with a Bucyrus-Erie 28-L spudder on the job, not only for drilling top-to-bottom, but also for rapid servicing and tailing-in operations. Check these 28-L special features and find out why!

1 Hard-hitting drilling motion produces sharp, penetrating blows that add extra feet of hole every hour.

2 Chain driven sand reel can pull bailer from depth of 3000 feet in three minutes. Free wheeling for fast lowering.

3 Gear driven casing reel with single part line on first layer has maximum pull of 16,400 pounds in low gear, 8600 pounds in high gear.

4 Bull reel can pull 3000 pounds of tools from 2500 feet in less than eight minutes. Automatic spooling device for smooth, even cable winding.

5 The 54-foot telescoping derrick permits use of large bailers and long tool strings; handles static casing loads up to 75,000 pounds with strut and auxiliary leg.

6 Two speeds forward and one reverse on all reels provide the split-second control required by diversified operations.

In handling drilling to 2500 feet or servicing to 3000 feet, you'll find the 28-L can mean added profits. Investigate the 28-L and its companion models — 24-L, 36-L, 48-L. You'll find there's a modern mobile Bucyrus-Erie spudder for every job range. See your nearest Bucyrus-Erie spudder distributor for complete information.

71550

BUCYRUS ERIE South Milwaukee, Wisconsin

Distributors in All Principal Oil Fields

Drill Sales Division Offices

Dallas, Tex., Evansville, Ind., Englewood, N. J.

structure, and that any test should be carried through all possible productive zones below the Dakota. Water in the Dakota does not condemn lower horizons. Eastern Colorado still has possibilities below the Dakota.

The western half of the state has a history somewhat different from that of the area east of the mountains. Exploration and development came much later and have not been so widespread.

The northwest corner is covered by Tertiary formations, which are productive. Below the Tertiary, the formations are comparable with the Cretaceous of eastern Colorado, and production is found in similar horizons. Structural features are sharper because of the widespread igneous activity. Faulting seems to be more common, and displacements are greater. For this reason the Dakota may be found productive more often owing to the fault traps or strong closures.

The Mancos shale, which is the geologic equivalent of the Pierre and Nio-Benton of the Plains region, overlies the Dakota throughout the region. Some oil production is found in this formation in nearly all western Colorado fields. The Mancos thins to the south but in Continental Oil Company's well in Mesa County, TWP-9s-R-91W, it was more than 6500 feet thick. This was was drilled to a total depth of 10,815 feet. It entered the Mancos at approximately 4300 feet and never reached the Dakota. Because of the great thickness of the Mancos in this district, it is possible that prospecting may be retarded, particularly as the underlying Dakota may carry water in this synclinal area. The depth problem is akin to that found in prospecting in the Denver basin on the eastern front.

Below the Dakota lies the Flaming Gorge or Morrison of Jurassic age. (This is the equivalent of the McElmo.) The Jurassic also carries the Sundance sand, which is sometimes productive. In the southwest corner, the La Plata becomes the equivalent of the Sundance and White Cliff. The Triassic of the western slope is represented by the Vermillion Cliff in the northern part and the Dolores in the southern part. There is apparently no equivalent of these in the Plains region.

The Permian of the Western Slope is found in the Park City or Aubrey in the north and the Cutler in the south. These apparently correspond to the Lykins and Lyons of the Front Range and the Embar of Wyoming.

There have been few tests of deeper horizons on the Western Slope. Two wells in Montrose County, one in TWP 47N-R 19W, and one in TWP 46N-R 17W, apparently reached the salt beds of the Pennsylvanian. The deep test in the Rangely field drilled into the Weber of Permian-Pennsylvanian age. The Buford well in Rio Blanco County, TWP 1N-R 91W, has drilled into the Madison lime of Mississippian age at 4527 feet. A well on Skull Creek in Moffat County, 16-4N-101W, also reached the Madison at about 3000 feet.

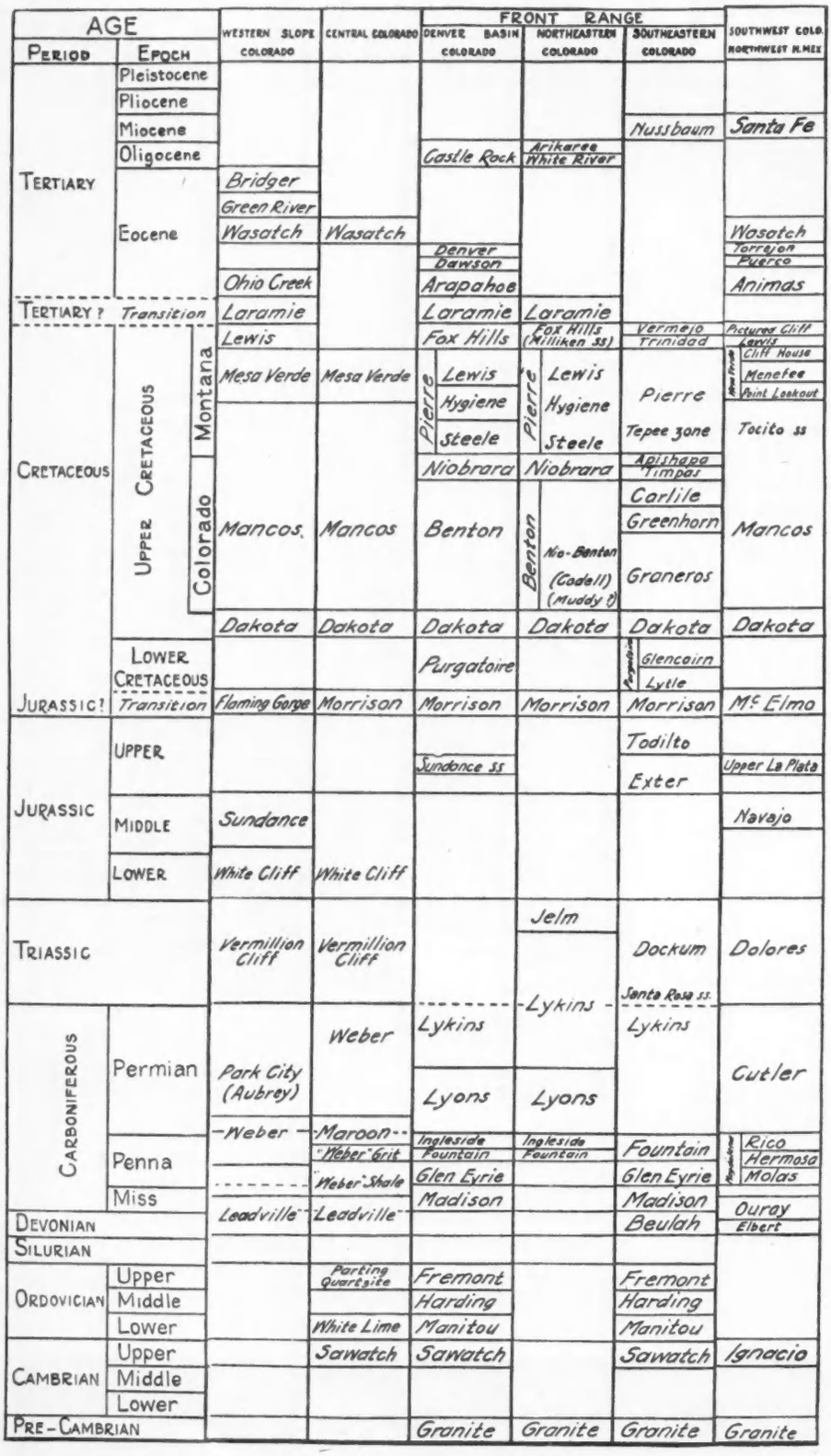


FIGURE 1. Geologic sections and correlations in Colorado.

ACKNOWLEDGMENT

The correlation chart for the district of Colorado shown in Figure 1 was furnished through the courtesy of C. E. Shoenfelt and is taken from his chart for the entire Rocky Mountain region. A description of the several formations is given by M. Grace Wilmartin in the *Lexicon of Geologic Names of the United States*, parts 1 and 2, *Bulletin 896* of the U. S. Geological Survey, 1938.

NATIONAL BANK OF TULSA
DIRECTORS

H. G. BARNARD
Investments

PHILIP H. BOHART
Vice-President,
Gulf Oil Corporation

A. E. BRADSHAW
President, National Bank of Tulsa

FALKNER C. BROACH
Vice-President,
National Bank of Tulsa

W. A. BROWNLEE
Executive Vice-President,
National Bank of Tulsa

J. A. CHAPMAN
Investments

JOHN H. DUNKIN
Vice-President and
Secretary, Brown-Dunkin Company

E. I. HANLON
President,
Hanlon Oil Company

J. J. LARKIN
President,
Larkin Torpedo Company

P. C. LAUINGER
President, The Petroleum Publishing Company

HENRY L. PHILLIPS
President, Sinclair Oil & Gas Company

L. C. RITTS
Investments

A. H. Rogers
Secretary, J. A. Chapman and H. G. Barnard

DALE R. SNOW
Vice-President,
Sunray Oil Corporation

FRANK M. SOWLE
Vice-President,
National Bank of Tulsa

CHARLES A. STEELE
Attorney-at-Law

C. H. SWEET
Vice-President,
National Bank of Tulsa

STATEMENT OF CONDITION

December 30, 1950

RESOURCES

Cash and Due from Banks	$ 68,686,232.57	
U. S. Government Securities	86,035,326.30	
Other Bonds and Warrants	9,252,627.95	$ 163,974,186.82
Loans and Discounts		44,042,763.89
Overdrafts		3,123.53
Income Receivable Accrued		464,223.11
Prepaid Expenses		35,095.38
Stock in Federal Reserve Bank		180,000.00
Bank Premises		2,000,000.00
Customers' Liability Under Acceptances		35,640.00
Customers' Liability Under Letters of Credit		2,250,999.46
TOTAL		$ 212,986,032.19

LIABILITIES

Deposits		$ 198,119,006.92
Acceptances Executed		35,640.00
Letters of Credit Outstanding		2,250,999.46
Income Collected, Not Earned		189,484.14
Reserve for Taxes, Interest, Etc.		862,426.10
Dividends Declared*		150,000.00
Capital—Common	$ 3,000,000.00	
Surplus	3,000,000.00	
Undivided Profits and Reserves	5,378,475.57	11,378,475.57
TOTAL		$ 212,986,032.19

*Payable $75,000.00 January 15, 1951, $75,000.00 April 13, 1951

NATIONAL BANK OF TULSA

The Oil Bank of America

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

OFFERING COMPLETE BANKING AND TRUST SERVICES

1950 Exploration

13 Percent Above Record

LAST year was the most active period for exploratory drilling in the history of the industry and the total number of this type of wells completed topped the previous record-high reached in 1949 by more than 13 percent. From a numerical standpoint, the results of this stepped-up exploratory campaign were more successful than the previous period's, although they did not quite measure up percentagewise. And, of course, a comparison of the quality of the year's results can only come later.

A total of 8745 exploratory tests had been completed by the end of December to give 1950 a lead of 1024 wells or 13.3 percent over the previous record of 7721 wells drilled in 1949.

The 1950 exploration was considerably more successful than that of the

Summary of Results of Exploratory Drilling

ITEM	Dec., 1950	Nov., 1950	TOTAL YEAR January-December 1950	1949	Percent Diff.
Oil Discoveries	112	91	1,117	964	+ 15.9
New Fields	79	61	816	668	+ 22.2
New Pays	33	30	301	296	+ 1.7
Distillate Discoveries	4	6	85	121	— 29.8
New Fields	3	6	67	69	— 2.9
New Pays	1		18	52	— 65.4
Gas Discoveries	10	11	145	179	— 19.0
New Fields	8	9	126	130	— 3.1
New Pays	2	2	19	49	— 61.2
Total Discoveries	126	108	1,347	1,264	+ 6.6
Extensions to Fields	20	24	323	325	— 0.6
Oil Fields	18	21	285	273	+ 4.4
Distillate Fields		3	12	16	— 25.0
Gas Fields	2		26	36	— 27.8
Total Prod. Tests	146	132	1,670	1,589	+ 5.1
Dry Holes	635	679	7,075	6,132	+ 15.4
Wildcats	603	637	6,775	5,914	+ 14.6
New Pays			8	46	— 82.6
Outposts	32	42	292	172	+ 69.8
Total Expl'tory Tests	781	811	8,745	7,721	+ 13.3
Percent Productive	18.7	16.3	19.1	20.6	
Percent Dry	81.3	83.7	80.9	79.4	

(See tables on pages 78-80.)

Results of Exploratory Drilling in December and Twelve Months, 1950-1949, by Districts

State or District	MONTH OF DECEMBER, 1950													YEAR, 1950																	
	Productive Tests									Total Productive	Unproductive Tests			Total Exploratory Tests	Productive Tests									Total Productive		Unproductive Tests				Total Exploratory Tests	
	New Fields			New Pays			Extensions				Wildcats	New Pays	Outposts		New Fields			New Pays			Extensions			12 Mo. 1950	12 Mo. 1949	Wildcats	New Pays	Outposts	Total Dry 12 Mo. 1950	Total Dry 12 Mo. 1949	12 Mo. 1950	12 Mo. 1949
	Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas						Oil	Dis.	Gas	Oil	Dis.	Gas	Oil	Dis.	Gas									
Alabama											2			2	1		1							2		20			20	13	22	13
Arizona																										8			8	5	8	5
Arkansas	1		1							2	9			11	9	1	1	1			2			14	14	84		2	86	85	100	99
California	1			4						5	27		4	36	17		1	13		1	19		3	54	40	342	3	39	384	372	438	412
Colorado	1		1						1	3	6		1	10	8		2			1			2	13	2	499		4	53	48	66	50
Florida																										8			8	15	8	15
Georgia																										4			4	4	4	4
Idaho																										5			5		5	
Illinois	2			1			5			8	65			73	24		1	21		1	69		2	118	113	729			729	653	847	766
Indiana	3			2						5	16			21	41			10			5			56	50	441		17	458	381	514	431
Kansas	13									13	79			92	105		6	2			2			115	90	651			651	411	766	501
Kentucky	4									4	17			21	20		1	3			3			27	34	108			108	134	135	168
Louisiana	2	1					1			4	33		1	38	30	10	2	17	9	3	10	4	2	87	114	246	1	7	254	223	341	337
North Louisiana		1								1	17		1	19	12	2		2	4	3	5	2	1	31	37	128	1	5	134	125	165	162
South Louisiana	2						1			3	16			19	18	8	2	15	5		5	2	1	56	77	118		2	120	98	176	175
Maryland																	1							1	1	3			3		4	1
Michigan	1									1	21			22	28		5	3		1	3			40	28	301			301	301	341	329
Mississippi	2			1						3	7		1	11	11	2		2				2		17	10	132	1	5	138	117	155	127
Missouri																										6			6	17	6	17
Montana											3		1	4	2						2		1	5	9	57		2	59	37	64	46
Nebraska			1							1	4			5	3		5				3		1	12	1	57		1	58	8	70	9
Nevada																										2			2		2	
New Mexico	3									3	4			7	14		2	5			10			31	26	68		6	74	63	105	89
New York																									1					14		15
North Carolina																														1		1
North Dakota											3			3												3			3	5	3	5
Ohio											2			2							2		2	4	9	16			16	37	20	46
Oklahoma	3	1		2		1				7	36			43	69	4	9	29	1	1	40	1	2	156	134	512			512	451	668	585
Oregon																														1		1
Pennsylvania																	1							1	18				29	1	47
South Dakota											1			1												8			8	6	8	6
Tennessee																									7	4			4	40	4	47
Texas	42	1	5	23	1	1	10		1	84	254		24	362	422	50	85	184	8	11	107	5	11	883	813	2787	2	195	2984	2472	3867	3285
Dist. 1 S. Central							1			1	16		3	20	14	2	1	2	1	1	2			23	22	203		6	209	239	232	261
Dist. 2 Middle Gulf	1	1		1					1	4	12		1	17	16	11	16	12	2	4	1	3	5	70	75	154		23	177	158	247	233
Dist. 3 Upper Gulf	4		1	8		1	1			15	30		1	46	23	16	7	48	2	4	14	2	4	120	112	243		17	260	247	380	359
Dist. 4 L. Gulf-SW	2			6	1					9	22		4	35	24	9	19	49	3	2				106	119	282		17	299	325	405	444
Dist. 5 E. Central	1						1			2	5			7	6	1	1	1			2			11	6	71			71	75	82	81
Dist. 6 Northeast											12			12	8	4		4			4		2	22	23	84	1	5	90	80	112	103
Dist. 7-B N. Central	15		3							18	66		2	86	150	3	20	12			11			196	156	633		21	654	543	850	699
Dist. 7-C W. Central	4			1			3			8	16		3	27	27	3	5	10			10			55	48	209	1	22	232	112	287	160
Dist. 8 West	4			5			2			11	33		5	49	63		1	35			38			137	113	308		28	336	187	473	300
Dist. 9 North	11		1	2			2			16	40		5	61	90	1	15	11			25			142	135	586		56	642	484	784	619
Dist. 10 Panhandle											2			2	1									1	4	14			14	22	15	26
Utah											3			3				2						2	3	18			18	23	20	26
Virginia																									4				3		7
Washington																										2			2	2	2	2
West Virginia																									31				26		57
Wyoming	1						2			3	11			14	12		3	9			8			32	37	104	1	14	119	135	151	172
Total U.S.	79	3	8	33	1	2	18		2	146	603		32	781	816	67	126	301	18	19	285	12	26	1670	1589	6775	8	292	7075	6132	8745	7721

It pays to use . . .

Strata-Seal

TRADE MARK

to combat lost circulation of drilling mud

Here's a remarkable new product to eliminate or reduce loss of circulation and returns. Recently made available to the oil industry, Strata-Seal has already proved to be one of the most highly effective developments in the long search for a practical material to combat lost circulation. It saves on mud costs, it cuts rig down time.

So effective is Strata-Seal's bridging action, that even in a number of extreme cases, it has restored circulation and saved abandonment of wells.

Check these savings with Strata-Seal

1. Strata-Seal protects investments by making possible reclamation of wells about to abandoned.
2. Eliminates or reduces rig down time.
3. Savings resulting from ability to screen.
4. Has no detrimental effect on viscosity, water content and gel strength of drilling fluid.
5. Is easily added to mud.
6. Does not interfere with coring operations

Available through leading mud service companies. See and feel Strata-Seal — write us for a free sample vial.
Write to Dept. 23

Strata-Crete

TRADE MARK

. . . an aggregate to lighten your cement slurries

More and more oil men are discovering that cement slurries made with Strata-Crete give them these four practical, valuable advantages — at low cost.

1. Strata-Crete substantially lightens the cement slurry.
2. With Strata-Crete, higher columns of cement can be pumped with lower pressures.
3. Strata-Crete and cement facilitates perforation.
4. Strata-Crete helps materially to reduce lost circulation of cement.

Manufactured to rigid specifications, Strata-Crete is a uniform aggregate which can be used with high early, slow set, or standard oil well cement. It's suitable as an admix in bulk cement, or can be mixed right on the job.

Strata-Crete is available through leading oil well cementing concerns. Write us for more information, and for sample vial. See for yourself the uniform quality, the light weight. *Write to Dept. 23.*

LOW COST

UNIFORMITY

4 CUBIC FEET

GLC®

STRATA-CRETE SALES

Great Lakes Carbon Corporation, 18 East 48th St., New York 17, N.Y.

Sales Offices in Principal Oil Centers

previous year in the number of new oil pools located. By the end of the year, 816 new oil fields and 301 new pay horizons in established oil fields had been found to account for 1117 new oil sources. A year earlier the count had been 668 new fields and 296 new pays, or 964 new oil pools.

In the case of distillate discoveries, the 1950 results were not so good. New fields totaling 67 and new pays numbering 18 for a total of 85 new distillate pools did not equal the 121 opened a year before. The big difference occurred in the number of new pay strata, as the number of new fields discovered were practically the same in the two years.

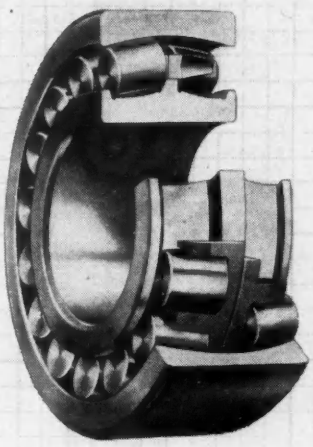
New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in United States in December, 1950

Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		ARKANSAS—New Oil Field						
Union	Ramsey Creek	Roberts Pet. Inc's Lena 1, C NE NE NE 26-17s-14w	12-30-50	3519	2930- 2932	Travis Peak sd; L. Cre.	P 105	18
		ARKANSAS—New Gas Field						
Franklin	Lone Elm	Arkansas Western Gas Co's Fee 1, Sect. 16-10n-28w	12-31-50	3584	2265- 2639	Atoka sd; Penn.	F 20 mln; Open	
		CALIFORNIA—New Oil Field						
Kern	Edison Groves	Richfield Oil Corp's Shields-Arms 1, Sect. 32-29s-29e	12- 4-50	3672	3480- 3500	Olcese sd; Mio.	F 217; $\frac{11}{64}$"	13.4
		CALIFORNIA—New Oil Pays						
Kern	MountainView	L. O. Tarrant's Zuver 1, Sect. 18-30s-29e. ½ mi ne of production	12-16-50	4456	4144-4218	Jeppi sd; Mio.	P 70	25
Los Angeles	Castaic Creek	The Texas Co's Honor Rancho 2, Sect. 1-4n-17w	12-11-50	6642	6408- 6527		F 116; 77 wtr	33.4
Los Angeles	Castaic Junct.	Humble O&R Co's N. L. & F. 3, Sect. 24-4n-17w	12- 7-50	10115	9815- 9865	Mohnian sd; Mio.	F 281; $\frac{1}{4}$"	22.2
Orange	Huntington Beach	Atlantic Oil Co's Miller & Ford 7, Sect. 10-6s-11w	11-30-50	3945	3733- 3819		P 84	20.8
		COLORADO—New Oil Field						
Logan	"Yenter"	British American's Koenig & Ashby 1, NW 3-8n-54w	12- 1-50	5250	5240- 5250	"J" sd; U. Cre.	P 225; $\frac{5}{8}$"	
		COLORADO—New Gas Field						
LaPlata	"Ignacio"	Stanolind's Ute-Indian B-1, C SE NE 18-33n-7w	12-15-50	7914	7568- 7770	Morrison sd; Jur.	F 3.7 mln.	
		COLORADO—Gas Field Extension						
Morgan	Lee	J. M. Huber Corp's Gov't-Lee 1, NE SW NE 1-2n-57w. ½ mi e ext	12-28-50	5544	5530- 5540	Dakota sd; U. Cre.	F 0.6 mln.	
		ILLINOIS—New Oil Fields						
Clay	Hord	Ashland et al's G. F. Van Dyke 1, SE SW NE 14-5n-6e	12-31-50	2954	2810- 2819	McClosky li; Miss.	P 300; 200 wtr	
Saline	Omaha, W.	Skiles Oil Corp's Bramlett 1-E, SW NE SE 36-7s-7e	12- 5-50	2846	2517- 2532 2812- 2843	Cypress sd; Miss. Aux Vases sd; Miss.	P 63	
		ILLINOIS—New Oil Pay						
Richland	Clay City-Noble Cons.	P. Fulk's H. E. Coen et al 1, SE NW SE 3-3n-9e. ½ mi extension	12-19-50	4786	3534- 3600	Salem li; Miss.	P 126; 44 wtr	
		ILLINOIS—Oil Field Extensions						
Effingham	Bible Grove, N.	Sun Drlg. Co's W. D. Lake 1, SE NE SW 15-6n-7e. ¾ mi s ext	12- 5-50	2985	2555- 2561	Cypress sd; Miss.	P 8; 6 wtr	
Hamilton	Rural Hill	Stewart Oil Co's U. Foster 1, NE SW SW 22-6s-5e. ½ mi w ext	12-19-50	3212	3192- 3209	Aux Vases sd; Miss.	P 117	
Richland	Clay City-Noble Cons.	P. Fulk's C. Robards 1 SW SW 10-3n-9e. ½ mi extension	12- 5-50	3642	3580- 3591	Salem li; Miss.	P 7; 40 wtr	
Richland	Olney, S.	Miami Operating Co's E. Kurtz 1, SE SE NE 21-3n-10e. 1¼ mi s ext	12-31-50	3283	3166- 3170	Rosiclare li; Miss.	P 113	
White	Phillipstown Cons.	J. Hinkle's Perkins 1, NW NW NE 24-3s-10e. ½ mi w extension	12-31-50	3215	3186- 3190	McClosky li; Miss.	P 40; 70 wtr	
		INDIANA—New Oil Fields						
Posey		V. R. Gallagher-Ind. Farm Bur.'s Arthur Toran 1, SE SE SE 16-6s-14w	12-21-50	2345	2122- 2133	Waltersburg sd; U. Miss	P 440	
Posey		Ryan Oil Co's Oscar Buchanan 1, NE NE NW 22-6s-13w	12-12-50	2930	2766- 2772	Aux Vases li; Miss.	P 114	
Vanderburgh		Barron Kidd's Albert Martin 1, NW SW NW 5-5s-11w	12-17-50	2550	2224- 2238	Cypress sd; Miss.	P 15; 150 wtr	
		INDIANA—New Oil Pays						
Daviess	Un-named	E. Michel's Caswell Woodruff 2, NE NW SW 34-5n-6w	12-16-50	765	763- 765	McClosky li; Miss.	P 125	
Knox	Monroe City, N.	Graham Dev. Co's Anna E. Myers 3, NW SW SW 1-2n-9w	12-12-50	1568	1556- 1568	Rosiclare li; Miss.	P 45	
		KANSAS—New Oil Fields						
Barton	Hiss, S.	Petroleum, Inc's Benjamin 1, NE SE SW 31-20s-13w	12-26-50	3592	3542- 3542	Arbuckle li; Ord.	P 395	
Barton	Reif, S.	Chas. Carlock's Klug 1, SE SE SW 31-16s-12w	12- 7-50	3438	3172- 3177	Lansing-K.C. li; Penn.	P 34	
Barton	Leoville, S.E.	Derby Drlg. Co's Curtis 2, NW NW SE 7-17s-14w	12-14-50	3414	3407- 3414	Arbuckle li; Ord.	P 443	
Ellis		Continental's Vine 1, NE NE NW 23-11s-19w	12-10-50	3485	3466- 3485	Arbuckle li; Ord.	P 120	
Morris	3-Mile Creek, S.	R. Loriaux' Gross 1, NE NE SE 35-16s-5e	12-28-50	2211	2204- 2211	Mississippi li; Miss.	P 35	
Nemaha	Sabetha	Carter Oil Co's O. Strahm 1, NW SW NW 13-2s-14e	12- 4-50	3929	2827- 2834	Hunton li; Devo-Sil.	P 319	
Phillips	Stuttgart	Imperial Pet. Co's Vogel 1, SE SE NE 14-3s-19w	12-17-50	3150	3146- 3150	Lansing-K.C. li; Penn.	P 503	
Rice	Munyon	Carl Lebsack et al's Munyon 1, NE NE SW 34-18s-10w	12-16-50	3285	3270- 3281	Arbuckle li; Ord.	P 204	
Rooks		Derby Oil Co. et al's Whisman 1, NW NW SE 9-9s-20w	12-28-50	3702	3427- 3436	Lansing-K.C. li; Penn.	P 4	
Saline	Smolan	W. E. Studnicka et al's Richter 1, SE SE SW 19-15s-3w	12-11-50	3391	3385- 3391	Viola li; Ord.	P 132	
Stafford		Anschutz Drlg. Co's Langer 1, SE SE NE 4-21s-14w	12-27-50	3582	3578- 3582	Arbuckle li; Ord.	P 608	
Stafford	McGinty	Champlin Refg. Co's McGinty 1, SW SE NE 13-21s-14w	12- 8-50	3680	3505- 3513	Lansing-K.C. li; Penn.	P 101	
Trego	Walz	Peel & Hardman's Walz 1, SE SE SW 12-11s-21w	12- 5-50	3680	3660- 3680	Arbuckle li; Ord.	P 397	
		KENTUCKY—New Oil Fields						
Hancock		R. F. McMahan's Bertie Ford 1, SE NW NW 16-N-32	12-21-50	1021	993- 1021	Cypress sd; Miss.	P 4	
Ohio		Earl Briney's Jas. Roby 1, NE SE SW 16-O-33	12- 6-50	820	805- 820	Cypress sd; Miss.	P 30	
Webster		Ryan Oil Co's Tony Stinnett 1, SE NE NW 25-M-33	12-15-50	3215	3109- 3113	O'Hara li; Miss.	P 51	
Webster		Skiles Oil & Bayer Pet. Co's Luke Osborne 1, 6-N-23	12- 4-50	1949	1927- 1949	Tar Springs sd; U. Miss.	P 127	
		NORTH LOUISIANA—New Distillate Field						
Tensas	"Newellton"	David M. Lide Co. et al's Mrs. H. L. Jacoby et al 1, Sect. 1-12n-12e	12- 1-50	8820	8810- 8820	Tuscaloosa Massive sd; U. Cre.	F 529; 1.7 mln.; ¼"	54.5
		SOUTH LOUISIANA—New Oil Fields						
Acadia	Trilby, N E.	Bates & Cornell's August Leonards 1, Sect. 29-7s-1e	12-19-50	9976	9953- 9969	Miocene sd; Mio.	F 330; $\frac{7}{32}$"	44.4
Avoyelles		Gulf Refg. Co's Ben J. Altheimer et al 2, Sect. 24-4n-4e	12-19-50	6518	4446- 4448	Wilcox sd; Eoc.	F 63; 27 wtr; $\frac{1}{8}$"	30
		SOUTH LOUISIANA—Oil Field Extension						
Calcasieu	DeQuincy	Niloco Co's Ind. Lbr. Co. 1-C, C SW NW SE 35-7s-11w. ½ mi n ext	12-29-50	6850	5218- 5220	Miocene	F 118; $\frac{7}{64}$"	24.9
		MICHIGAN—New Oil Field						
Gladwin	"Skeels"	Don Rayburn's Cassidy 1, S½ SW SE 30-20n-2w	12-15-50	3847	3830- 3847	Dundee dolo; Devo.	F 130	
		MISSISSIPPI—New Oil Fields						
Adams	New Era	R. J. Bartlett & Barnett Serio's Geo. W. Armstrong 1, Sect. 37-6n-3w	12-28-50	6761	6325- 6327	McKitterick sd; Eoc.	P 85; 35 wtr	41.8
Sharkey	Cary	Memphis Pet. Corp's Houston 1, C NW NW NW 23-11n-7w	11-21-50	3256	3254- 3260	Gas Rock sd; U. Cre.	P 70; 2175 wtr	25
		MISSISSIPPI—New Oil Pay						
Jones	Ovett	Ginther-Warren & Ginther's L. L. Majors 1, C SE NW 2-6n-11w. 1 mi se of production.	12-29-50	9032	7348- 7380	Eutaw sd; U. Cre.	P 80	10
		NEBRASKA—New Gas Field						
Cheyenne		Ohio Oil Co's State 1, NW NW SW 16-13n-50w	12-21-50	5410	4802- 4829	1st Dakota sd; U. Cre.	F 8.8 mln.	
		NEW MEXICO—New Oil Fields						
Chaves		Earl G. Levicks' State 1, C NW NE 7-8s-27e	12-10-50	1990	1960- 1990		P 5	24.5
Chaves		Magnolia's C. L. O'Brien 1-B, C NW NW 1-9s-28e	12-10-50	7666	7253- 7259	Devonian li; Devo.	F 270; ¼"	54.2
Eddy		Martin Yates Jr. Est's Featherstone-State 1, NW NE SW 32-19s-27e	12- 5-50	361	349- 361	Queen sd; Perm.	P 50	35

[1] Character of producing formations abbreviated thus: ch, chalk; dolo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing, (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.



when the drilling is tough

TORRINGTON SPHERICAL ROLLER BEARINGS

Wilson Manufacturing Company backs up drill bits with smoother power, easier control and rugged construction in its Giant Remote Control Rigs.

Torrington Spherical Roller Bearings are used in many applications in Wilson rigs. Despite heavy loads Spherical Roller Bearings deliver power efficiently without developing binding stresses under shaft deflection. Accuracy of contact between rollers and races provides high capacity, insures stamina and low maintenance on exacting drilling schedules.

Automatic self-alignment, high load capacity and precision operation are features of Spherical Roller Bearings that can help you improve performance of your equipment. Call in a Torrington engineer to help you work out details of design and application.

THE TORRINGTON COMPANY

South Bend 21, Ind. • Torrington, Conn.

District Offices and Distributors in Principal Cities of United States and Canada

TORRINGTON SPHERICAL ROLLER BEARINGS

SPHERICAL ROLLER
TAPERED ROLLER
STRAIGHT ROLLER
NEEDLE
BALL
NEEDLE ROLLERS

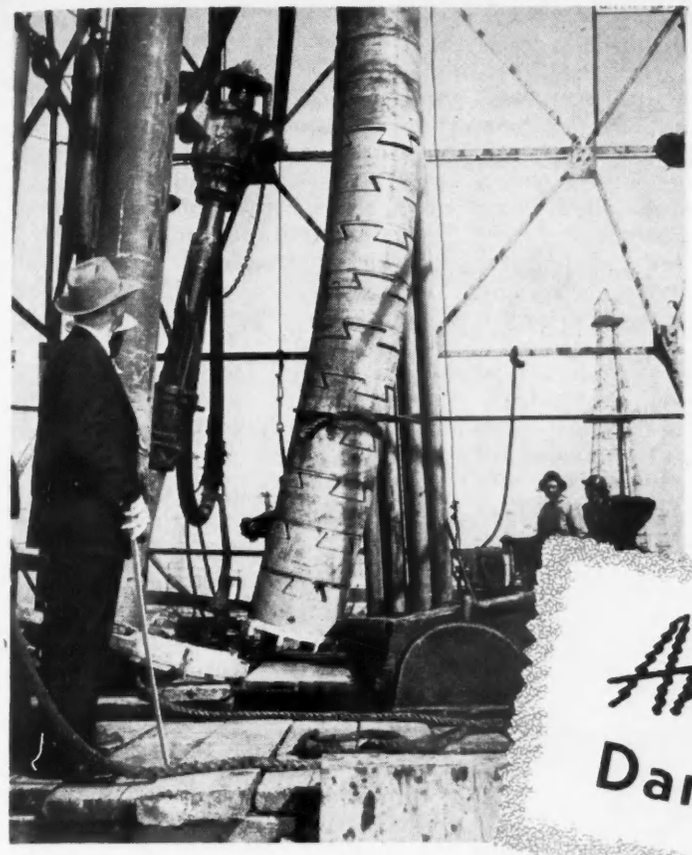
New Oil, Distillate and Gas Fields and New Pay Horizons Discovered in United States in December, 1950

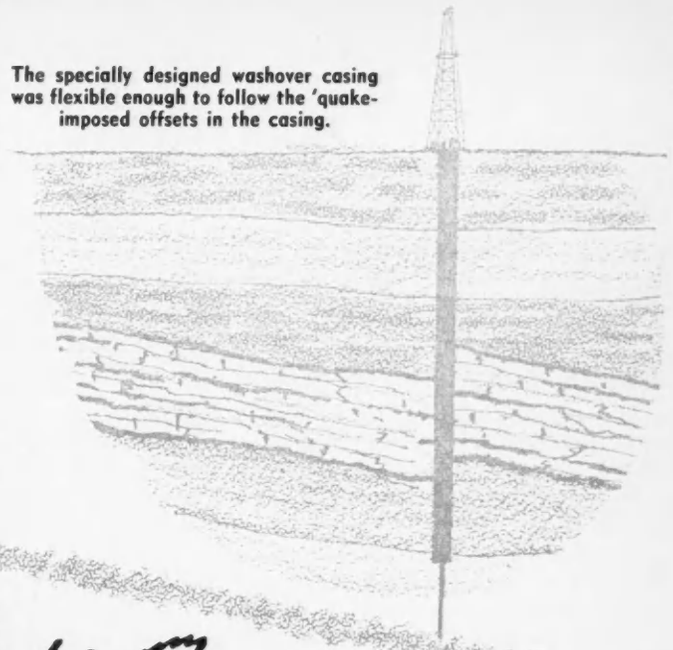
Also Important Extensions to Established Fields

COUNTY	FIELD	COMPANY, WELL AND LOCATION	Date Completed	Total Depth (Feet)	Completion Horizon (Feet)	[1]Name, Character and Age of Producing Formation	[2]Initial Production Method and Choke	Gravity of Oil
		OKLAHOMA—New Oil Fields						
Creek	.....	Misel Bros' Mollie Crow 1, SW SE SE 29-17n-10e	12-14-50	2685	2682- 2685	Dutcher sd; Penn.	F 75; 7/64"	....
Lincoln	Prague, W.	Ned E. Biffle's Way 1, NW NW SE 19-12n-6e	12-10-50	4700	4430- 4470	Misener sd; Miss.	F 520	41
Okfuskee	.....	Kenneth Ellison's Geo. D. Foster 1, NE SW SE 6-13n-9e	12-12-50	3274	3263- 3274	Dutcher sd; Penn.	P 14	37
		OKLAHOMA—New Oil Pays						
Logan	Marshall, N.	Ashland O&R Co's Rouse 1, NW NW SW 9-19n-4w. ½ mi from prod.	12-24-50	6477	6292- 6310	Simpson dolo; Ord.	P 47	42
Seminole	Tyrola, E.	S. Marvin et al's Rogers 1-A, SW NW NW 12-5n-6e	12- 8-50	2043	1996- 2005	Thurman sd; Penn.	P 8	....
		OKLAHOMA—New Distillate Field						
Coal	.....	Ohio Oil Co's H. A. Jones 1, SE SE NW 35-3n-11e	12-21-50	9823	8954- 9085	Bromide sd; Ord.	F no gge; 2.1 mln; 11/64"	dist.
		OKLAHOMA—New Gas Pay						
Logan	Union Valley	Robt M. Jordan's Gates 1, E½ SW NE 29-16n-1w	12-13-50	5798	1335- 1405	Layton sd; Penn.	F 11 mln.	....
		TEXAS—District 1 (SOUTH CENTRAL)—Oil Field Extension						
Wilson	E. Floresville	Morris Cannan & Van Zandt's Arthur Ridout 1, Jno. W. Brown Sur. ½ mi ne extension.	12-11-50	2749	2731- 2749	Poth sd; Eoc.	P 84	23
		TEXAS—District 2 (MIDDLE GULF)—New Oil Field						
Victoria	.....	Quintana Pet. Corp's Henderson & Pickering 1-B, A. B. Williams Sur	12- 2-50	7020	6852- 6855	.....	F 124; 3/4"	48.3
		TEXAS—District 2 (MIDDLE GULF)—New Oil Pay						
Refugio	Boehm	Arnold O. Morgan's Ed Fricke 1, Esteban Lopez Sur	12-17-50	6608	5297- 5301	.....	F 79; 1/2"	42
		TEXAS—District 2 (MIDDLE GULF)—New Distillate Field						
Lavaca	.....	Horrigan & Foh's Rosie Martisak et al 1, Jno. Morris Sur	12-10-50	9906	9696- 9736	Wilcox sd; Eoc.	F 74; 0.7 mln; 1/16"	49
		TEXAS—District 2 (MIDDLE GULF)—Gas Field Extension						
Goliad	Albrecht	Rupert Cox & Dan Clark's A. Coutret 1, M. J. de Ybarbo Sur. ¾ mi w ext.	12-20-50	4825	4680- 4746	Yegua sd; Eoc.	F 0.6 mln; 1/8"	....
		TEXAS—District 3 (UPPER GULF)—New Oil Fields						
Chambers	.....	Humble O&R Co's Galveston Bay State 1-F, Sect. 26-A	12-14-50	9050	8298- 8306	.....	F 176; 1/4"	....
Liberty	Dayton, N.	The Texas Co's J. D. Williams 4, H&TC Sur	12-23-50	5050	5041- 5050	.....	F 211; 3/32"	32.2
Matagorda	Oliver Point	Brazos O&G Co's St. of Texas "O"-1, State Tr. 302, Matagorda Bay	12-21-50	5907	5163- 5165	.....	F 38; 11 wtr	31
Washington	.....	Cox & Hamon's Bessie T. Hughes 1, E. R. Miller & W. R. Munson Surs	12- 8-50	9712	9365- 9369	Wilcox sd; Eoc.	F 241; 1/4"	36
		TEXAS—District 3 (UPPER GULF)—New Oil Pays						
Colorado	Hamel	Warren Oil Corp's Warren-Fidelity A. Boeker 1, Richard Dowdy Sur	12-14-50	9712	8678- 8688	.....	F 445; 1/4"	37.6
Hardin	Batson	L. D. Cain's Marrs McLean 1, F. H. Green Sur	12- 9-50	6314	6203- 6234	B. Yegua sd; Eoc.	F 157; 3/4"	38.5
Harris	Durkee	Union Producing Co's Settegast 1, H&TC RR Sur	12-26-50	7792	7053- 7055	Yegua sd; Eoc.	F 180; 3/4"	35.1
Harris	Pierce Junct.	Albert Plummer's Kate F. Whitehead 4, Sect 51, Jas. Hamilton Sur	12-31-50	5545	5456- 5462	.....	F 142; 3/8"	36.3
Jefferson	Big Hill, N.	McCarthy O&G Co's W. D. Davidson Est. 1-B, J. E. Broussard Sur	12- 4-50	11417	8424- 8432	.....	F 214; 1/4"	40
Matagorda	Midfields	Sinclair's E. A. Fleury 1, Geo. W. Nexsen Sur	12-21-50	11126	10383-10388	Frio sd; Olig.	F 325; 1/4"	49.2
Tyler	Fred	Standlind O&G Co's Jas. F. Parker et al 5, Geo. T. W. Collins Sur	12- 4-50	9005	8532- 8542	Wilcox sd; Eoc.	F 81; 1/16"	46
Wharton	Hutchins-Kubela	Henry C. Adams' J. F. Kubela Est. 2, H&TC Sur 4	12-27-50	4664	4659- 4663	.....	F 132; 1/8"	24.5
		TEXAS—District 3 (UPPER GULF)—Oil Field Extension						
Orange	Rose City	Jno. W. Mecom's Wm. Saenger et al 1, Gilbert Stephenson Sur. ½ mi n ext.	12- 4-50	8369	8100- 8108	Hackberry sd; Olig.	F 258; 1/8"	39.8
		TEXAS—District 3 (UPPER GULF)—New Gas Field						
Fort Bend	.....	Harold Link's Horelica 2, Sect. 66, H&TC Sur	12-13-50	5321	5246- 5253	.....	No gge.	....
		TEXAS—District 3 (UPPER GULF)—New Gas Pay						
Wharton	Lane City	Sohio Pet. Co's Mrs. Jennie Beard 2, Sylvanus Castleman Sur	12-20-50	5668	5423- 5428	.....	No gge.	....
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Fields						
San Patricio	Sinton, N.	Arnold O. Morgan's R. H. Welder 1-D, Eliza H Welder Subd	11- 7-50	7505	2370- 2372	.....	F 93; 1/4"	22
Starr	"Rudeo"	Rudeo O&G Co's Yturria Ld. & Livestock Co. 1, Sect. 47, Proc. 100	11-30-50	6011	4092- 4102	Frio sd; Olig.	P 83	45.9
		TEXAS—District 4 (LOWER GULF-S.W.)—New Oil Pays						
Jim Hogg	Edlasater	Gorman & De Lange et al's Mary M. Lasater Est. 20, Wm. Key Sur	12-21-50	2451	2441- 2446	.....	P 88	....
Jim Wells	Amargosa	Geo. W. Graham's Lester Moore 2-A, J. Poitevent Sur. 97	12-30-50	6808	6095- 6102	Pettus li; Eoc.	P 10	45
Kenedy	Rita	Humble O&R Co's Mrs. S. K. East 9, Los Finados Gr	11-15-50	9000	4574- 4590	.....	F 30; open	39.6
San Patricio	La Copita	Rowan & Hope's Bentsen Bros. 5-B, CCSD&RGNG RR Sur	11-20-50	4990	4539- 4542	U. Frio sd; Olig.	F 14; 12 wtr; 1/8"	42.7
San Patricio	Sinton, N.	Plymouth Oil Co's R. H. Welder 3-A, (OWDD), E. H. Welder Rch Subd	12-20-50	7410	5967- 5977	.....	F 113; 1/8"	35.6
San Patricio	W. Taft	Union Oil of Calif.'s R. H. Welder 1-B, Welder Ranch Subd	11-23-50	7302	3984- 3990	.....	F 53; 1/16"	21.7
		TEXAS—District 4 (LOWER GULF-S.W.)—New Distillate Field						
Hidalgo	Edinburg	Magnolia Pet Co's Julia Gannaway 1, Lot 3, Tex-Mex. RR Sur. 1¼ mi nw of production.	12-24-50	8260	7788- 7798	.....	F 33; 4.9 mln; 1/16"	47.6
		TEXAS—District 5 (EAST CENTRAL)—New Oil Field						
Falls	Wash-Tex	Wash-Tex Oil Co's T. H. Thigpen 1, Geo. Leonard Sur	11-21-50	1361	1341- 1349	Edwards li; L. Cre	P 62	31.1
		TEXAS—District 5 (EAST CENTRAL)—Oil Field Extension						
Hopkins	Pickton, S.E.	Delta Drlg. Co's S. M. Taylor 1, Robert Earp Sur. 2 mi e ext	12-15-50	7927	7884- 7897	Bacon li; L. Cre.	F 299; 1/4"	....
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Fields						
Crockett	.....	C. S. Jones' University 1-F, Sect. 36, Blk 30, Univ. Lds. Sur	11-10-50	1335	1292- 1335	Permian	P 23	30.2
Schleicher	.....	Frank & Geo. Frankel et al's R. S. Williams et al 1, Sect. 26, HE&WT Sur.	12- 9-50	7341	4288- 4305	Clear Fork li; Perm.	F 299; 1/2"	34.2
Sutton	.....	C. L. Norsworthy, Jr. & Lone Star Prod. Co's R. N. Thomson 1, Sect. 67, Blk A, HE&WT Sur.	12-28-50	7441	930- 980	U. Permian	P 56	38
Upton	.....	Sinclair O&G Co's G. R. Davis 1, Sect. 20, Blk 41, T-5-S, T&P Sur	12-16-50	13363	13153-13178	Ellenburger dolo; Ord.	F 175; 21 wtr; 1/4"	53.6
		TEXAS—District 7-C (WEST CENTRAL)—New Oil Pay						
Tom Green	Pulliam	Sun Oil Co's C. Linthicum 3 (OWWO), Sect. 1, Blk 4, H&TC Sur	12- 3-50	5495	5165- 5198	Palo Pinto li; Penn.	F 128; 1/4"	36.5
		TEXAS—District 7-C (WEST CENTRAL)—Oil Field Extensions						
Crockett	Wyatt-San Andres	Oliver & Kotyza's Todd 1-A, Sect. 35, Blk WX, GC&SF Sur. ½ mi s ext.	12-20-50	1342	1326- 1342	San Andres li; Perm.	F 39; 1/2"	23.7
Kimble	Ken	West Texas Oil & Royalty Co. et al's Mrs. W. Faulkner 1, Sect. 80, Blk A, GWT&P Sur. ½ mi ne extension.	12-28-50	3157	2900- 2918	Strawn sd; Penn.	P 74	29.7
Runnels	Winters, W-Canyon	J. K. Hughes' W. F. Menzenmeyer 1, Sect. 58, Blk. 63, A. G. Sawyer Sur. ½ mi n extension.	11-23-50	4728	3494- 3502	Canyon sd; Penn.	P 120	41.2
		TEXAS—District 8 (WEST)—New Oil Fields						
Ector	.....	Texas Gulf Prod. Co's Woodward et al 1, Sect. 9, Blk. 45, T-2-S, T&P Sur.	12- 2-50	8440	6158- 6285	Tubb sd; Perm.	F 438; 3/32"	40
Howard	.....	Fred M. Manning, Inc's Chester L. Jones 1, Sect. 5, Blk. 25, H&TC Sur.	12-20-50	8453	7698- 7703	Canyon Reef li; Penn.	F 268; 3/64"	46
Howard	.....	Stanolind's C. W. Burton 1, Sect. 27, Blk 33, T-2-N, T&P Sur	12-16-50	9618	8870- 8920	Canyon Reef li; Penn.	F 217; 11/64"	45
Midland	.....	Magnolia's H. F. Timmerman 1, Sect. 8, Blk. 40, T-3-S, T&P Sur	12- 6-50	13030	10440-10485	Pennsylvania sd; Penn.	F 400; 1/16"	44.2
		TEXAS—District 8 (WEST)—New Oil Pays						
Gaines	Jenkins	The Texas Co's Southland Royalty Co. 1, Sect. 7, Blk. A-25, PSL Sur	12-31-50	9173	4543- 4820	San Andres li; Perm.	P 106	30.8
Martin	Blk 7-Ellen.	The Texas Co's State 1-X, (OWWO), Sect. 17, Blk 7, Univ Lds. Sur	12-22-50	13420	12280-12295	Devonian li; Devo.	F 390; 5/32"	45
Midland	Sweetie Peck-Ellen.	Benson-Montin, Inc's Abbie Peck 1, Sect. 20, Blk. 41, T-4-S, T&P Sur	12- 8-50	13307	12505-12555	Fusselman li; Sil.	F 241; 1/16"	50
Scurry	Diamond-M	Hiawatha O&G Co's L. M. Wilson 9, Sect. 183, Blk. 97, H&TC Sur	12- 4-50	3132	2380- 2458	San Andres li; Perm.	P 16; 10 wtr	33
Scurry	Diamond-M-San Andres	Robert W. McKissick's Hugh Birdwell 1, Sect. 177, Blk. 97, H&TC Sur. 1 mi se extension	12-14-50	3250	2438- 2475	San Andres li; Perm.	P 30	39
		TEXAS—District 8 (WEST)—Oil Field Extensions						
Howard	Vealmoor	L. H. Armer, et al's S. L. Lockhart 1, Sect. 34, Blk. 32, T-C-N, T&P Sur. ½ mi ne extension.	12-10-50	7905	7890- 7902	Canyon Reef li; Penn.	F 86; 1/16"	45.2
Midland	Tex-Harvey	Carlton Beal's Corbin-Rosa 1-13, Sect. 13, Blk. 37, T-3-S, T&P Sur. 1 mi e extension.	12- 1-50	7234	6960- 7234	Spraberry sd; Perm.	F 27; 1/2"	37.4
		WYOMING—New Oil Field						
Washakie	Nowood	V. Ziegler & Bay Pet. Co's Voss 1, SE SW 5-48n-90w	10-15-50	1612	1610- 1612	Tensleep sd; Penn.	P 22; 50 wtr	....
		WYOMING—Oil Field Extensions						
Big Horn	Garland	M. D. Smith's Crosby 1, Sect. 14-44n-62w. 1 mi se extension	12-15-50	3296	3214- 3286	Frontier sd; U. Cre.	P 35	....
Convers	Glenrock, S.	Ralph Lowe et al's W. E. Barber 1, SW NW NE 17-33n-75w. ¾ mi e ext.	10-17-50	5815	5732- 5740	Muddy sd; U. Cre.	F 1776; 3/4"	....

[1] Character of producing formations abbreviated thus: ch, chalk; dclo, dolomite; li, limestone; sd, sandstone; sh, shale; ser, serpentine; cgl, conglomerate. Ages of formation abbreviated thus: Plio, Pliocene; Mio, Miocene; Olig, Oligocene; Eoc, Eocene; U. Cre, Upper Cretaceous; L. Cre, Lower Cretaceous; Jur, Jurassic; Tri, Triassic; Perm, Permian; Penn, Pennsylvanian; U. Miss, Upper Mississippian; L. Miss, Lower Mississippian; Devo, Devonian; Sil, Silurian; Ord, Ordovician; Cam, Cambrian.

[2] Barrels of oil per day (24 hour rate), flowing, (F), pumping (P), swabbing (Sw), or bailing (B); or million cubic feet of gas daily open flow capacity; size of choke in inches.





The specially designed washover casing was flexible enough to follow the 'quake-imposed offsets in the casing.

Anti-Earthquake Damage Operations

By D. L. ROBERTS

Chief Petroleum Engineer, E. B. Hall & Company, Los Angeles

TWO unusual earthquakes have occurred in the Wilmington oil field within the past three years. They were unusual in that they were "minor" from the standpoint of earth shock but disastrous from the standpoint of damage to oil wells. The first, in December, 1947, affected a large number of Long Beach Oil Development Company wells but only a small number of Union Pacific Railroad Company wells, only two of the latter being rendered non-productive. The second earthquake took place in November, 1949, and resulted in damage to a large number of Union Pacific wells. Approximately one-half of these wells were so severely damaged as to prevent them from being produced. Geographically, severe damage to Union Pacific wells was concentrated in an area approximately 5000 feet long and 2000 feet wide on Terminal Island.

The damage to wells results from the fact that horizontal earth movement takes place along definite slippage planes during the quakes. Survey techniques evolved to measure the severe deformations in well casings caused by this movement revealed that damage had occurred at approximately 1500 and 1700 feet. Most of the major damage from the second earthquake occurred at the lower level. Correlation of electric log markers showed that slippage planes existed in shale beds at these depths, and subsequent coring confirmed this conclusion. While an extreme variance of depths at which damage occurs of approximately 32 feet above and below the slippage plane exists, the majority of wells damaged have casing deformation within ten feet of the slippage plane. An average horizontal displacement at the lower level of about eight-tenths of one foot has been measured. The amount of casing affected by the slippage has been found to be as little as seven feet and as much as 28 feet.

Following the first of these earthquakes, Union Pacific adopted a policy of installing earthquake damage preventive measures in all new wells in the area of known damage. These measures consisted of the scraping of pockets, which varied in diameter from 20 to 30 inches, opposite the known slippage planes. Theoretical investigations of the probable stress involved in earth movements over large areas revealed that any attempts to strengthen well casings so as to be capable of withstanding such movement would be ineffective. A policy of providing larger than normal hole around the casing was therefore instituted, the basic theory being predicated on preventing transmission of formation movement to the casing, or spreading the deformation resulting from such movement over a sufficient

UNUSUAL TECHNIQUES are being devised in the Wilmington field of Southern California to repair wells whose casings have been severely damaged by earthquakes. The amount of casing affected has been found to be as little as seven feet and as much as 28 feet. Steps taken to repair and work over damaged wells, some so severely damaged as to prevent their being operated, as well as measures devised to minimize further damage in the event of occurrence of future slippages at these levels, currently are under way by operators in the affected part of the field.

length of casing so as to prevent severe damage.

Design of New Wells

Following the second earthquake, a correlated program of designing wells to prevent or minimize future damage, and at the same time provide facilities for economic repair of damaged wells, was evolved. This consisted of the setting of approximately 200 feet of 30-inch outside diameter, ⅜-inch wall slipjoint casing, the drilling of 26-inch hole to several hundred feet below the lowest known slippage plane, and the packing of the resultant annulus between the formation wall and the 8⅝ or 7-inch casing with a material suitable for the preservation of the annulus.

The exact practice used in making these installations varies slightly from well to well, but essentially is as follows:

Approximately five feet of 38-inch casing is installed when the rig foundation is built. A specially designed riser (approximately eight feet long) is then flanged to the cellar floor. An 18⅝-inch hole is drilled to approximately 210 feet, and is then opened to 36 inches in diameter. Both blade type scrapers and roller cutter hole openers are used for this purpose. This hole is ordinarily drilled and opened in about 30 hours. Thirty-inch casing is then cemented solidly at approximately 200 feet. Conventional methods of cementing, using a backcheck valve shoe, were employed in the first few wells. The time delay inherent in drilling out a large cast iron insert containing the backcheck valve has been eliminated by redesign of the shoe which resulted in elimination of the insert.

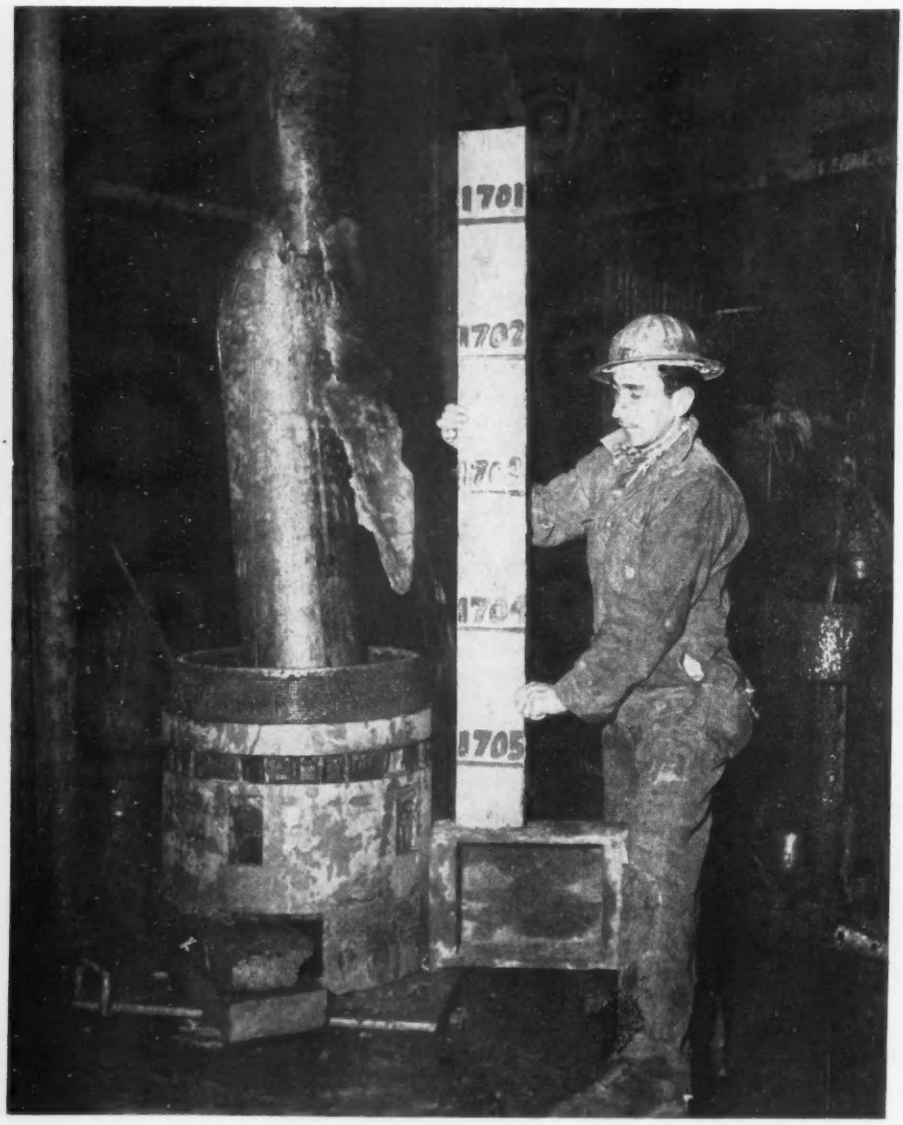
At present, the cementing is done by running 3½-inch internal flush drill pipe to five feet above the shoe. A specially designed stripper head is then installed between the drill pipe and 30-inch casing. The cement is pumped through the drill pipe until cement returns are observed. Water is pumped down the drill pipe to clear it of cement; the drill pipe is then pulled through the stripper as high as possible in the derrick or mast and the cement is allowed to set three hours, after which the drill pipe is pulled out of the hole.

The alluvial formations in which the surface casing is set are poorly consolidated. Difficulty in cementing surface pipe has been encountered in the past, and at present a mixture of "exploded" perlite in the proportion of 1½ cubic feet of perlite to one sack of cement is being used. This mixture results in greater slurry yield per sack of cement (resulting in lower costs), and low slurry weight which has reduced cement losses.

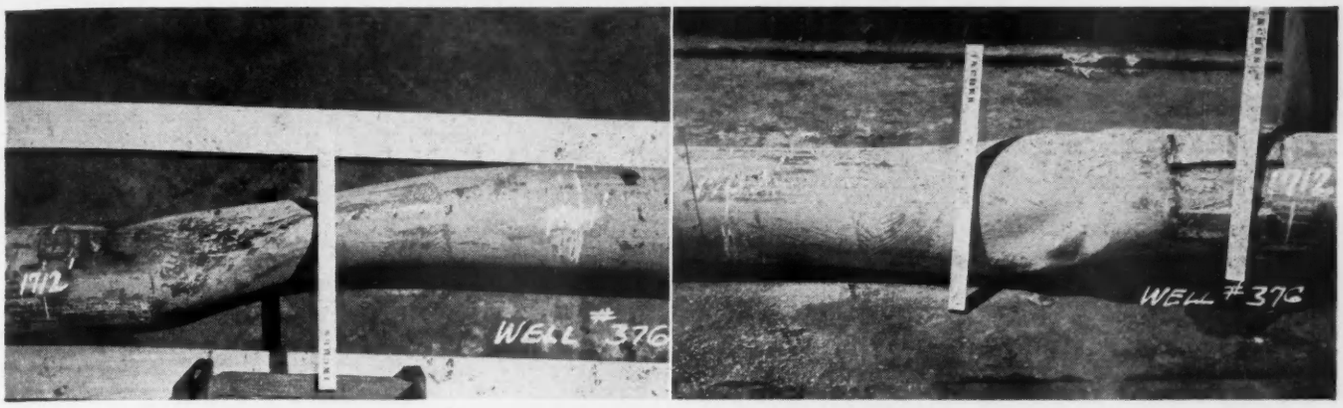
Blowout prevention prior to the setting of the oil string casing is provided by a specially made split ring which flanges to the top of the 30-inch casing. This ring in turn supports a specially designed double type head with a 26⅞-inch opening. After the 7 or 8⅝-inch casing is cemented, conventional blowout prevention equipment is installed.

After drilling out the 30-inch casing shoe, an 18⅝ x 12¼-inch "center punch" bit is run to the bottom of the existing 18⅝-inch hole. Approximately two feet of 12¼-inch hole is drilled in order to centralize the 12¼-inch bit which subsequently is run. The 12¼-inch hole then is drilled to a depth approximately 300 feet below the lower slippage plane. The diameter of hole drilled below this point is dependent upon the size of casing to be set. If seven-inch casing is to be set, 9⅝-inch hole is drilled; 8⅝-inch casing is set in 12¼-inch hole. Upon reaching the casing setting point an electric log is run and the hole is opened to 26 inches in diameter to approximately 2000 feet.

Normally, this is done in two stages; the 12¼-inch hole is opened to 18⅝ inches, which in turn is opened to 26 inches in diameter. The pilot type roller cutter hole openers used are conventional in design, although the 26-inch tool is unconventional as regards size, weighing 1710 pounds. In all operations described above, clay-base mud is used as the drilling fluid except wells in which coring, testing, etc., is to be done above the casing



This section of 10¾-inch casing was recovered from UP 403, Wilmington field, and shows shock-type deformation at lower earthquake damage level. The specially designed outside casing cutter carries the cutting knives in the rectangular pockets at the level of the base of the vertical scale stick.



RIGHT: Section of 10¾-inch casing recovered from UP 376, Wilmington Field. Plastic type deformation (eight-inch offset in four feet) at lower earthquake damage zone. The lugs welded across the pipe at the section marked "1712" are remnants of steel straps that were welded across the sheared or damaged section. These straps were placed as soon as the section was cut and pulled from the well, being designed to insure that the lower portion of the damaged joint would not break loose and fall back into the hole as it was being removed from the cutting tool. LEFT: Side view of the same casing joint, showing the extent of deformation laterally by the earthquake wave.

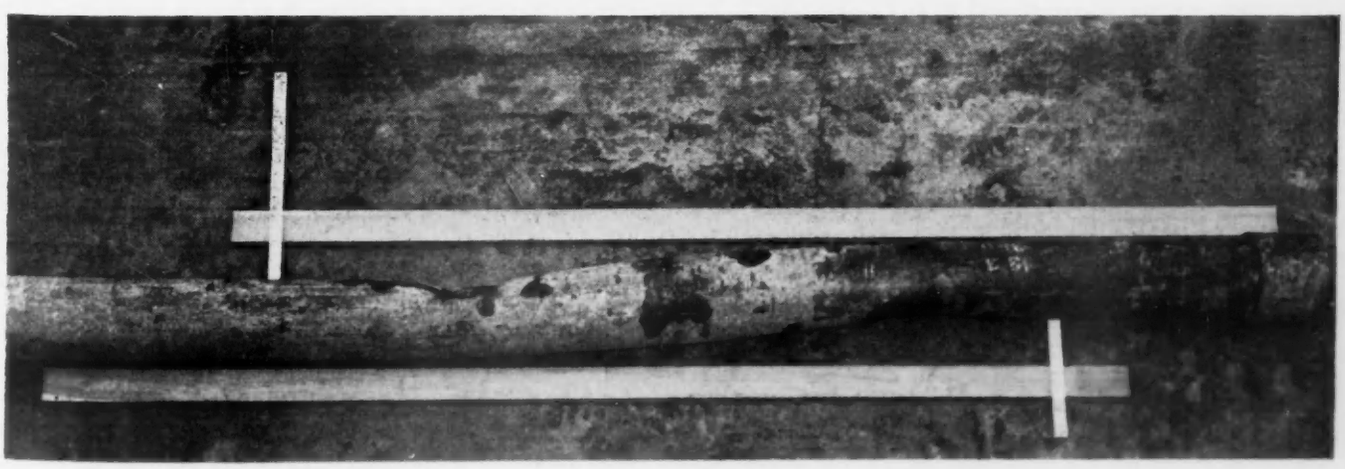
point. Four or five days normally are required for the hole-opening operation. Investigation of vertical drilling fluid velocities in the 26-inch diameter hole was made prior to acceptance of the program. This indicated that velocities as low as .4 feet per second could be expected if standard pump sizes and rates were used. Since this figure is low when compared to accepted standards, experiments were conducted by adding an extra pump to the system. Subsequent experience has shown that maintenance of drilling fluid in good condition, not velocities, is the primary factor, and very little difficulty has been encountered in this regard. Caliper logs of the large diameter hole were made in a number of the first wells drilled in this fashion, and it was found that the hole diameter was satisfactory so long as good mud control was used.

Many wells drilled in this fashion are directionally controlled. Where possible, the well is designed so that directional work will not be done in the hole which is subsequently to be opened to 26-inch diameter. However, in some instances, wells have been kicked off in the hole which subsequently is opened, and directional work done without difficulty. No difficulty has been encountered opening the hole.

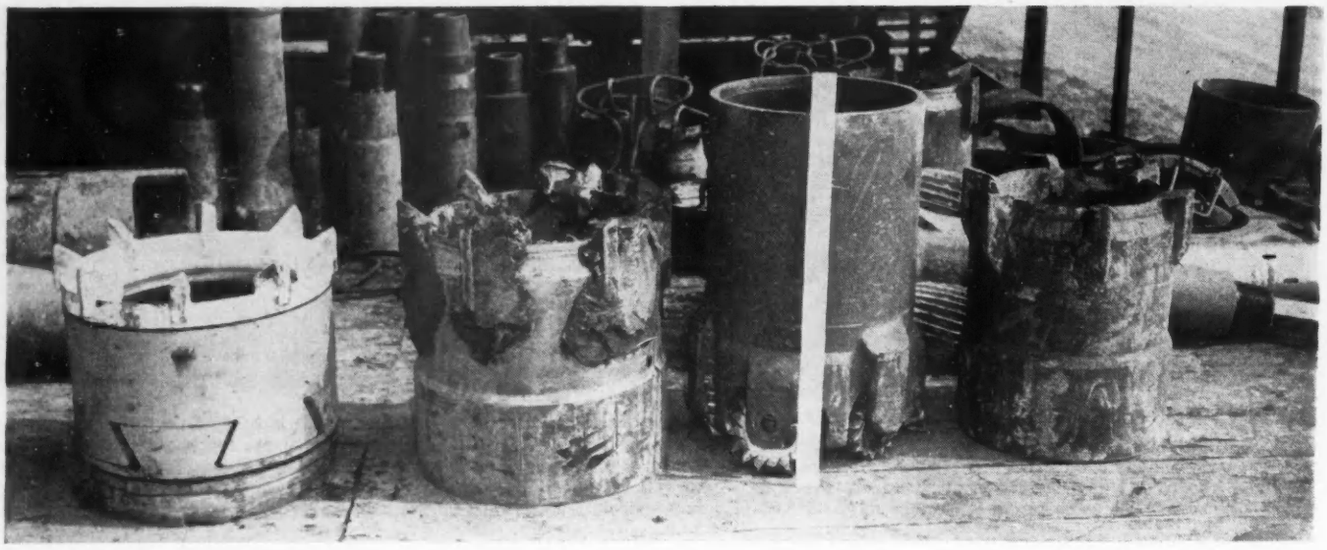
After conditioning the hole, casing is set and cemented in normal fashion. A port collar is installed approximately ten feet below the bottom of the 26-inch diameter hole. The cement is calculated to fill to the port collar. Difficulty was encountered early in the program in preventing cement from channeling into the large hole, although no large quantities of cement above the port collar were found. Two methods of controlling the height of rise of the cement have been used with excellent results. First, series of cement slurry mixes of graduated weight and viscosity were evolved. Each was selected largely on the basis of the height to which the cement had to be pumped. Bentonite type clays and "exploded" perlite have been used to obtain desired slurry weights and viscosities. Secondly, the rate of displacement of the cement was increased considerably above normal practice. Temperature surveys indicated that a deviation of approximately 4 percent between actual and calculated rises has been attained in most cases since the changes were made.

After displacement of the cement, the port collar is opened as soon as practicable and the annulus circulated thoroughly with clay-base mud. The mud is treated, if necessary, in order to condition the annulus for placement of a special packing material. The annulus then is completely displaced with an emulsion type mud which is treated to obtain a very low water loss and an extremely high gel strength. After complete gellation, the consistency of the mud pack is such that a pencil thrust into it will remain upright indefinitely. Measurement of the gel strength is made by use of a specially modified shearometer tube. The success of the program is demonstrated by the fact that less than 94 percent of the calculated displacement volume has been placed in only a very few cases. In some cases, 106 percent of the calculated displacement volume has been reached.

After completion of the above



Typical artificially deformed test specimen, bent to conform to damage as exhibited in upper right photo.



Left to right: Drag-type washover shoe for flexible washover joint; drag-type washover shoe for use on 21-inch washover pipe; roller cutter shoe; drag-type shoe for use on 16-inch washover casing.

work, the well is completed in normal fashion.

The uppermost sediments on Union Pacific's property, to a depth of approximately 1450 feet, are comprised largely of clay and silt members and medium to coarse-grained unconsolidated sands. Since the entire program is predicated on maintenance of the large hole diameter in order to permit earth slippage without transmittal of large localized stress concentrations, it is essential that the diameter of the hole be maintained. In order to determine the effectiveness of the fluid used in the annulus in this regard, the annuli are refilled periodically, and a program of thief sampling of the fluid has been instituted.

Recovery of Damaged Wells

Following the earthquake, remedial and recovering processes were evaluated both from the point of view of mechanical effectiveness and of economics. A series of experiments were conducted both on surface test specimens and on wells. From these, it was concluded that any attempt to repair wells from the "inside" (i.e., milling, swaging, etc., inside the casing) was unlikely to succeed due to the unique type of deformation encountered. The lateral slippage spoken of above usually results in the offsetting of two more or less parallel limbs of the casing. As a result, attempts to remove the constriction by milling or swaging almost invariably results in cutting or breaking the side wall or pipe, thus permitting the tool to follow a prolongation of the axis of the upper limb, rather than the axis of the bend. A specially designed flexible drill collar and rotary bit type swage was used to open severe constrictions in a test specimen to approximately normal internal diameter. A subsequent attempt to use this equipment to restore normal internal diameter in a well casing was abandoned because of slow progress. As a result, emphasis was given to other methods.

In order to provide the maximum amount of protection against potential earthquake damage, new wells designed to replace many of the wells which are completely unproducible have been drilled. A number of these have been completed and others are now being drilled.

At the same time, special tools were designed and built for washing over and recovering casing as large as 11¾ inches O.D. These consist of specially built drag type and roller cutter type washover shoes, heavy wall 16 and 20 inch washover casing fitted with tool joints, an external casing cutter and a flexible section of washover casing. The latter is made of a series of interlocking cast steel rings; the joints permit a deflection of approximately two feet laterally at the bottom of a ten-foot section of the casing. Each joint is sealed with a rubber insert sleeve so that circulation can be maintained through the section.

To date, three wells have been worked on with this equipment. One has been completely recovered; another was washed over to the 1700-foot level below which the well was deflected and redrilled. The third has been washed over to the 1700-foot level. The condition of the casing recovered by the use of this equipment indicates that the casing failures have been due to local concentrations of very large stresses. While some plastic deformation above and below the point of failure can be seen, the failure itself in one case exhibited characteristics more nearly associated with the result of high velocity shock wave than with the result of a relatively slow bending process.

In designing surface equipment for installation in wells in which the 26-inch diameter hole is to be drilled, the use of this speecial washover equipment for economic recovery of wells which may be damaged by future earthquake action was considered. Thus, the size of the surface casing was determined by the size of washover tools and pipe, since in the case of the wells which have been washed over to date it was found that removal of drive pipe and surface casing was costly and time consuming.

Since the final test of the effectiveness of the program for preventing or minimizing earth slippage damage to the wells necessarily involves the occurrence of another earthquake, a full evaluation of the program is not now available. However, theoretical evaluations of the program are being made and changes introduced as they are deemed necessary.

Unusual Causes of STEAM PUMP Troubles

By ROY E. EDWARDS
Mechanical Engineer, Quincy, Ill.

THROUGH A series of illustrative cases, the author investigates steam pump troubles and offers suggestions looking toward detection of the difficulties and changes in maintenance or operation procedures to avoid recurrence.

THE majority of complaints concerning reciprocating steam pumps are due to wear, lack of attention, improper fluid piston packing, valve seats or leaky stuffing boxes. However, occasionally difficulties from unusual causes are encountered. Since these troubles often take considerable time, money might be saved by a knowledge of them. The following are examples:

CASE 1: A steam pump had not been operating properly. Examination of the fluid end revealed the thread of a suction valve seat had been machined with a reconditioned die. Since the die was reground, it was over size, and it was necessary to run the die farther up on the thread to get the proper pitch diameter at the gauge point. Since the last part of the die had to travel farther along the length of the thread on the valve seat, the last half of the thread on the valve seat had the same pitch diameter as the last part of the die. The result was that half the thread on the valve seat was cut as a straight thread, and the other half—the top half, had the proper taper (Figure 1).

The thread leaked, thus preventing the pump from developing rated pressure. This caused the pump on one side to stroke faster in one direction than the other.

The remedy for this was to replace the seats.

If valves or valve seats are suspected of leaking, and if pressure is applied from some external source, the leakage can be determined by removing the discharge valves to test the suction valves, or the suction valves to test the discharge valves. If the suction is disconnected during the application of pressure to the valves, the leakage will be evident from the flow of fluid from the pump suction.

If there is leakage, the valves should be lapped to the seat and then tested again. If properly lapped and there is still a leak present, it is probably around the thread of the seat.

The seats should be removed and the thread should be examined. Seats with threads suspected of being defective should be replaced. Valves should be properly lapped to the new seats before placing the pump in service.

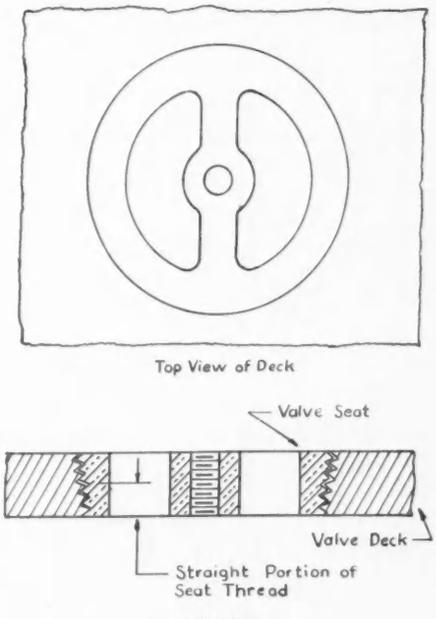


FIGURE 1

CASE 2: In this case, there was a casting hole through the stud boss in the fluid end, between the head end and the forward end of the fluid cylinder (Figure 2). This hole would permit fluid to leak from the pressure side of the piston to the suction side. Rated pressure was not developed.

This defect did not occur on preliminary test, but developed and became progressively worse in service from the continual application of heat and pressure. A hot fluid was being pumped.

In this case, the remedy was to replace the fluid cylinder of the pump.

CASE 3: The metal wall in the guide hole of a valve of a small duplex pump was machined too thin (Figure 3 (A)).

A similar failure was caused by drilling the guide hole too deep (Figure 3 (B)). When put in service, the thin wall cracked and caused the valve to leak. Cracks of this type can be detected by holding the valve to a strong light and looking down the guide hole.

The failure illustrated in Figure 3 (A) can occur if the design of a valve of this type does not allow for errors in manufacturing, such as improper centering of the valve during machining.

Figure 3 (B) is a failure caused by a machining error. The guide hole was drilled too deeply.

The remedy obviously was the replacement of the valve.

CASE 4: Another baffling problem

was caused by a liner in a pump fluid end. This liner did not fit tightly against the gasket between the liner gasket face and the gasket face in the fluid cylinder bore. A lump of metal on one of the liner bolt lugs prevented proper seating (Figure 4). This caused a pressure greater than rated pressure to be developed on the head end of the stroke on the side having the leaky gasket. It also permitted the cylinder on the leaky side to run faster than it should. The reason for this was that the piston rod became the effective piston as pressures were balanced on all areas except that of the rod. This cylinder was, in effect, a single acting plunger type.

The difficulty was hard to find because normally this would be the last place one would think of looking.

The faulty liner was not detected on the manufacturer's test because shop test liners were used and not the liners received with the pump. This was done to provide the customer with new liners of the size ordered from the warehouse.

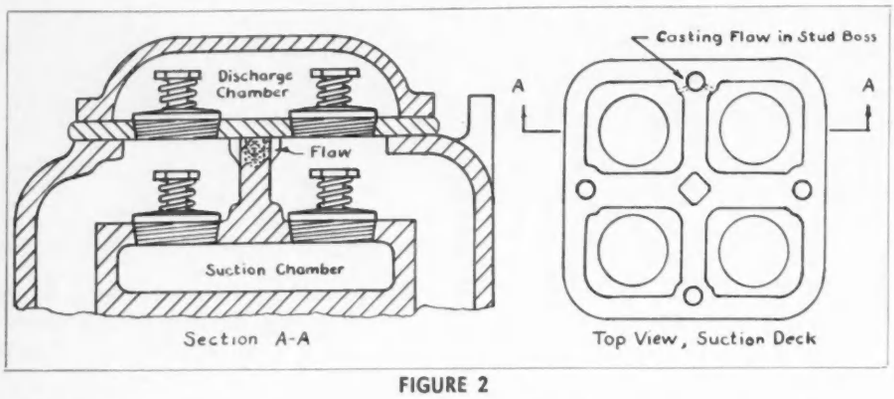


FIGURE 2

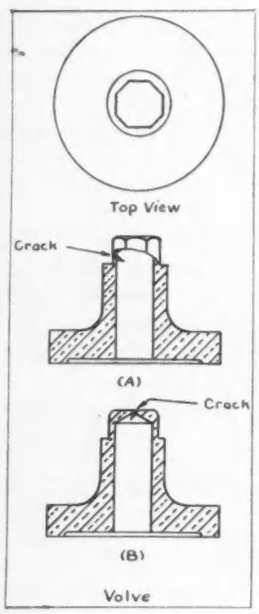


FIGURE 3

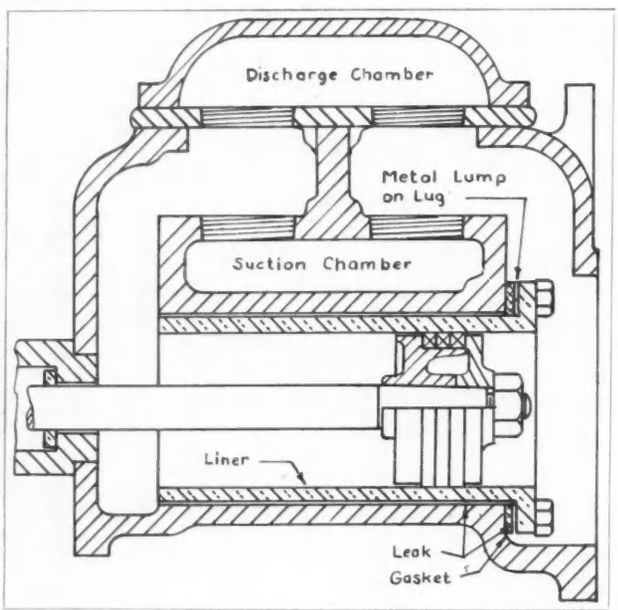


FIGURE 4

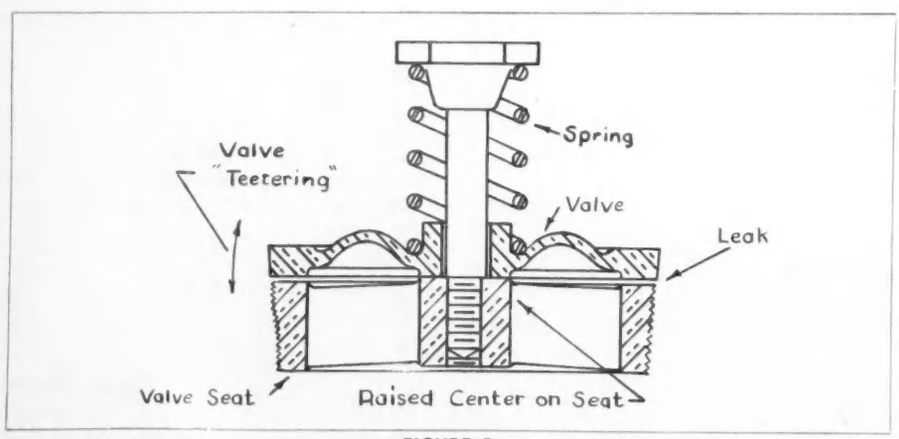


FIGURE 5

One way of checking this would be to take out the discharge valve in the forward end toward the steam end of the fluid cylinder to be tested, and then to remove the cylinder head. Water under pressure should then be applied to the discharge. Any leakage at the liner gasket can then be easily detected by observing the liner flange on the side tested.

Another means of testing would be to fill the forward end of the fluid end with water, and then remove the cylinder head. If the discharge line is then closed and steam pressure applied to the steam end, the water will be forced past the liner if there is a leak at this point. Since the cylinder head has been taken off, the leak will be clearly visible.

The remedy was to install a new liner.

Possibly in some cases the interfering metal can be ground off.

CASE 5: A boiler feed pump was noisy and caused the discharge line to vibrate. Careful inspection revealed that the suction valve was "teetering" on the valve seat (Figure 5). Since the valve seat had relatively thin metal sections to keep as large a fluid passage as possible, and since it was screwed into a tapered thread, it was possible to deform the ribs in the seat. This caused the surface at the center of the seat to project above the rim. For this design of valve to seal, it must seat on the surface at the center and at the rim.

Evidently the flow around the edge of the valve was not equally distributed. The local velocity probably varied from point to point around the edge of the valve. This caused the greatest pressure differential to be created at the point of maximum velocity. In an effort to reach a state of balance, the valve deflected downward at the point of maximum velocity. A state of unbalance was then created on the opposite side or at some other point on the rim, and the system tried to reach a state of balance again. Thus a waterhammer effect was created in the discharge line each time the valve changed position.

The valve causing this was a discharge valve.

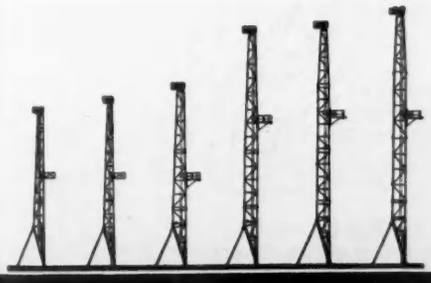
The remedy was to lap the valve to the seat.

CASE 6: A new pump was installed for handling heavy grease. The valve used was of the bonnet type (Figure 6). Apparently the valve opened sufficiently to strike against the bonnet. The partial vacuum created between the valve and the bonnet plus the adhesive force of the grease at the line of contact caused the valve to have a delayed closing action. This prevented

PLENTY OF *Working Space* IS A FEATURE OF LEE C. Moore MASTS

Pictured here is the bottom portion of a Lee C. Moore 133 feet Cantilever Mast. This picture illustrates the very generous floor space which is a feature of each Lee C. Moore Mast.

The rear legs of the mast are hinged to allow clearance for the largest drawworks.



LEE C. Moore

LEE C. MOORE CORPORATION

TULSA • DALLAS • HOUSTON • MIDLAND • SHREVEPORT • WICHITA • CENTRALIA • PITTSBURGH

Export Office — 9 Rockefeller Plaza, New York 20, N. Y.

the pump from operating properly.

Installing a valve as illustrated in Figure 5 eliminated the trouble.

A hole drilled in the side of the bonnet would equalize the pressure and a stronger spring would have overcome the adhesive force of the grease tending to stick the valve and the bonnet together at the rim of the bonnet.

CASE 7: A pump was short-stroking on one side at the head end and when the stroke was reversed, the piston moved with considerable speed toward the steam end. The cause of this was the collapsing of the liner under the liner packing by tightening the liner screws too much (Figure 7). The result was that the piston would stick in the collapsed section. When the stroke was reversed, the piston would "snap" loose when the pressure on the steam piston had become great enough to overcome the friction on the fluid position.

The remedy was to change the liner and correctly tighten the liner screws.

This trouble is more likely to be encountered on pumps that have external liner set screws, set screws that run through the cylinder head, if these screws are tightened during operation of the pump. This is because the force due to the pressure differential across the liner will be added to the force of the screws on the pressure stroke toward the head end of the fluid cylinder.

CASE 8: Leaky fluid piston packing can cause a pump to develop abnormal pressure, because the piston rod becomes the piston and the pump acts as a two cylinder single-acting plunger pump, or a pump having one double-acting cylinder and one single-acting cylinder. The effect of leaky piston packing is illustrated in Figure 8. In effect, it amounts to the removal of the piston. Since the fluid pressure depends on the ratio of the area of the fluid piston to the area of the steam piston, and due to leakage the piston rod has become the piston, it is obvious that several times the rated pressure can be developed, since the piston rod area is several times smaller than the normal piston area.

This may happen when a pump is first put in service because the piston packing was not properly fitted or did not conform to the liner.

The remedy was to repack the piston.

Leaky pistons can be checked as outlined under Case 4.

CASE 9: In the conventional double-acting duplex steam pump with no cushion valves or cushion leakoff, a leak can sometimes develop between the steam intake and the exhaust passages because of a casting flaw (Figure 9), which was not detectable until the pump had been in service for a short time. The continual application of heat and pressure in service can cause these defects to show, whereas a few minutes tests, after coming off the assembly line, would not.

An emergency remedy would be to drill small, equal-sized holes connecting the exhaust and intake passages on both sides of the pump. One of the holes would have to be drilled through the defect, if possible. If this is not possible, then the hole in the passage having the defect should be omitted. This creates a cushion leakoff on both sides of the pump.

This remedy, however, is more likely to be effective on small pumps than on large ones.

A more positive and certain remedy was to change the steam end.

A good moral to draw from these examples would be "Look for steam pump troubles in the fluid end first."

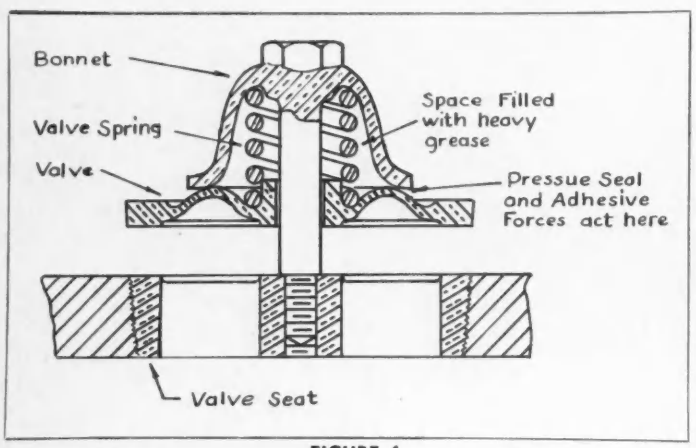


FIGURE 6

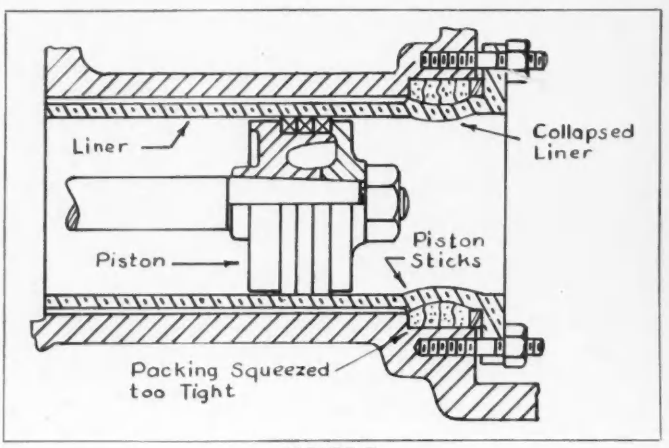


FIGURE 7

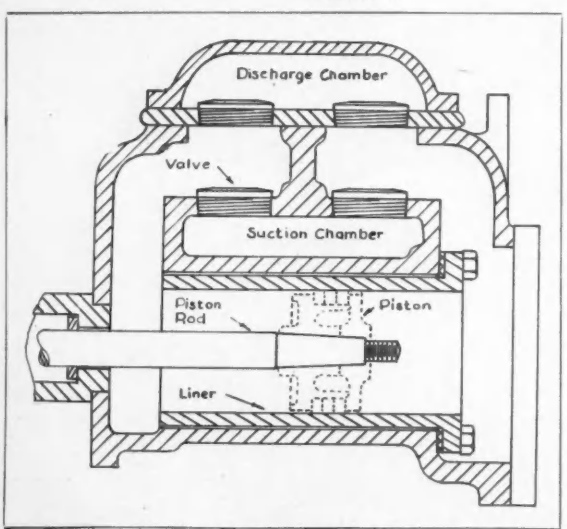


FIGURE 8

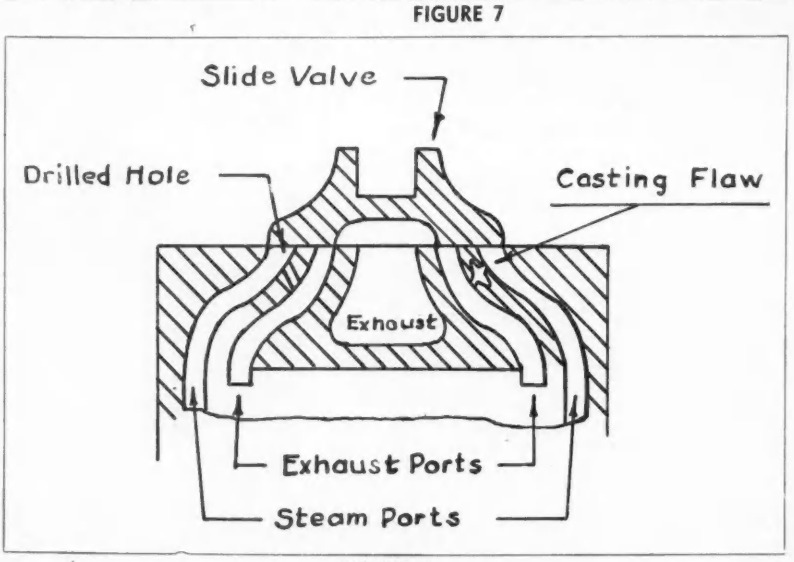
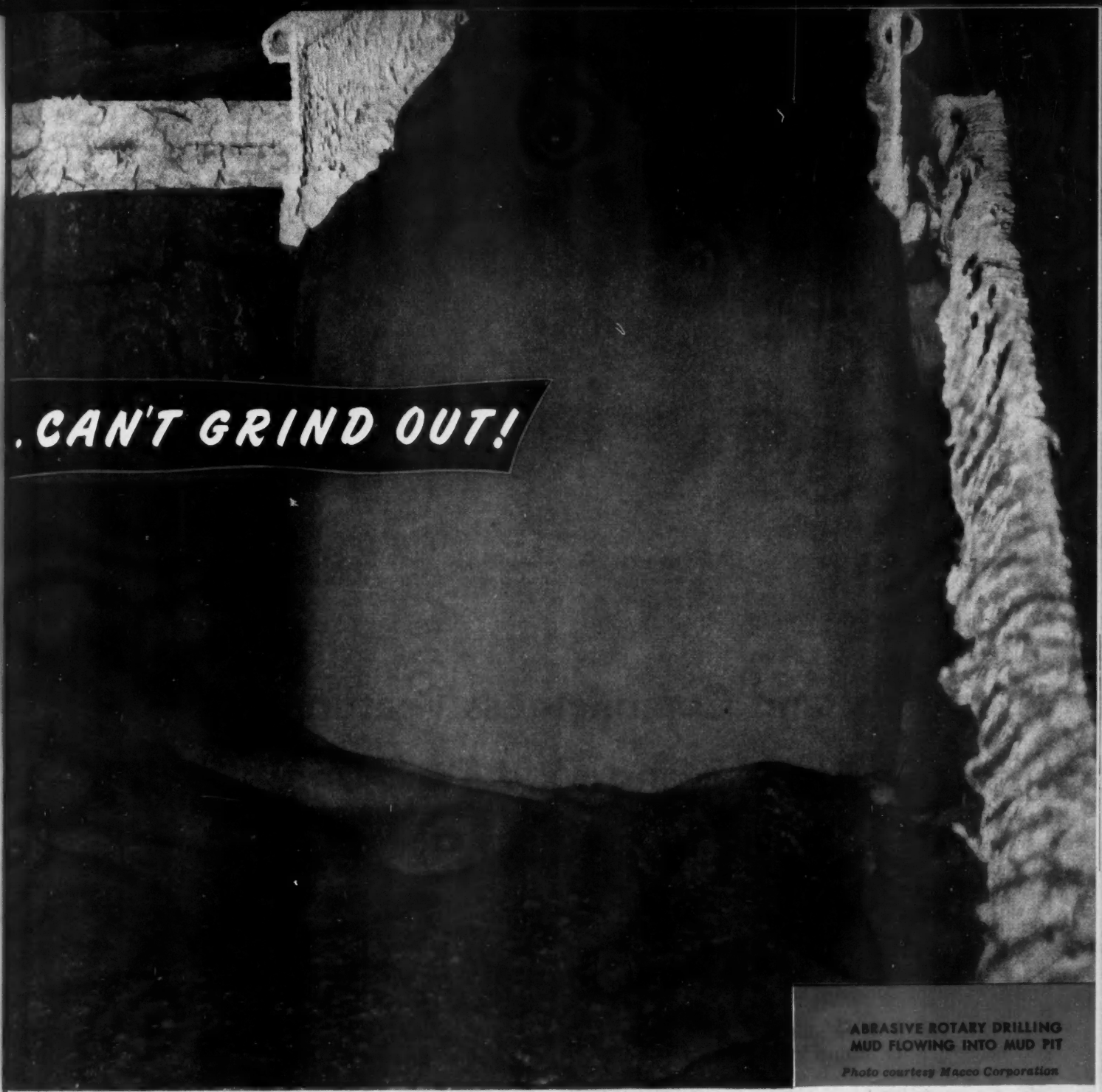


FIGURE 9



ABRASIVE ROTARY DRILLING
MUD FLOWING INTO MUD PIT
Photo courtesy Macco Corporation

5 TO 10 TIMES LONGER VALVE LIFE

You can prove to your own satisfaction the tremendously increased life of Nordstrom Merchrome coating mud line valves. Install one or several on the same lines where competitive valves are used. Compare length of life, ease of operation, freedom from leakage. You be the judge. Replace every worn valve with a Nordstrom.

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic
TRADE MARK
PATENTS APPLIED FOR

ROCKWELL MANUFACTURING COMPANY

400 North Lexington Avenue • Pittsburgh 8, Pennsylvania
Atlanta, Boston, Chicago, Columbus, Houston, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco, Seattle, Tulsa . . . and leading Supply Houses. Export: International Division, Rockwell Manufacturing Company, 7701 Empire State Bldg., New York 1, N. Y.

SPACE SAVING and minimum installation time are provided by this combination of units, which at the same time maintain rigid highway and load limits. Adoption of such grouping, especially in connection with jackknife rigs, is of material aid in reducing non-drilling time on the job.

By GILBERT M. WILSON
Pacific Coast District Editor

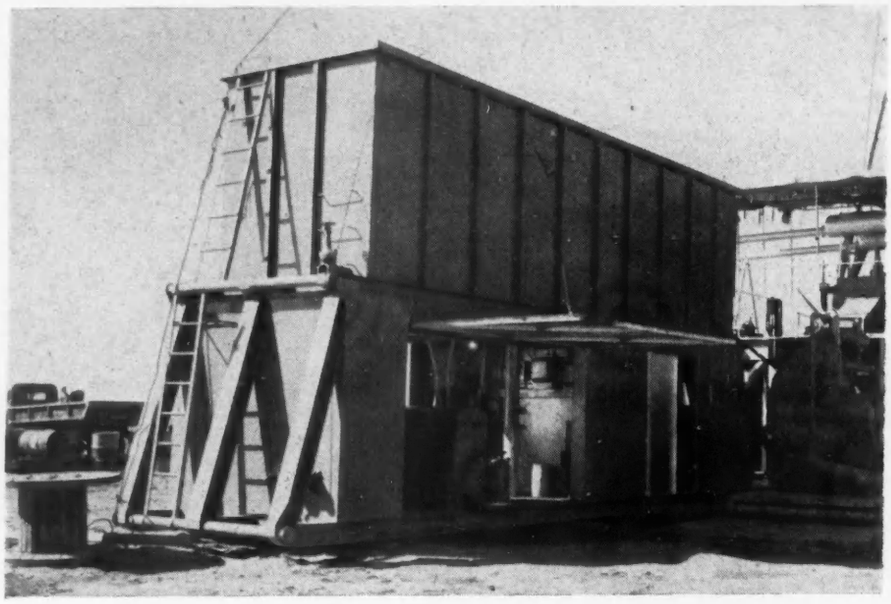


FIGURE 1. This combination generator house and tool house, and elevated 250-barrel tank provide for more efficient utilization of space. Both units are skidmounted and hauled as separate units.

Portability and Compactness Feature Generator House and Mud Tank Units

PORTABILITY and compactness, features which mark the streamlined drilling operations made possible by today's lighter jackknife-type drilling rigs, have been designed into the unique combination generator house and mud tank units employed by the Santa Fe Drilling Company, Santa Fe Springs, Calif.

Principal feature of the units, both skid mounted, is the manner in which the 250-barrel mud tank is mounted atop the generator house. This arrangement brings these units much closer to the rig floor where they are easily accessible, and permits a more efficient utilization of space and one which requires less piping and wiring ordinarily needed to hook up these facilities to mud lines and rig lighting equipment.

The units, shown in the installed position in Figure 1, are so designed that they may be set up quickly with only the aid of a winch truck. After the lower unit has been spotted, its axis being aligned with that of the longitudinal substructure members of the rig, the truck bearing the mud tank is backed up to it and a line and snatch block then connected to the rig end of the generator unit. The tank then is pulled up to its elevated position, guides welded at intervals along each side of the upper deck of the generator house preventing the tank from veering from its prescribed course. The problem presented by the fact that the upper deck is much higher than the truck bed height is overcome by the use of sloping, heavy bumper skids which are built into each end of the generator house unit. When the drill pipe bar connecting across the ends of the mud tank skid base is brought into contact with the sloping bumper skids, the tank unit starts to slope upward and ultimately slides into the guided track on top of the generator house unit.

Sturdily Built

The two units are of all-welded construction and have dimensions which conform to highway regulations. The generator house unit has an over-all length of 36 feet; width of 7 feet, 9 inches; and height of 8 feet. The open top mud tank has an over-all length of 33 feet, 8 inches; width of 7 feet, 6 inches; and height of 8 feet, 6⅜ inches.

The interior of the generator house actually is divided into two compartments by a steel partition. Two generator units, one of 25 kilowatts and a standby unit of 15 kw capacity, are mounted in the generator house section which occupies slightly more than 17 feet of the total length. The remainder of the unit space is taken up by a storage room and tool house.

The skid base members of the generator house consist of three 8x8 35-pound I-beams. The outside columns, bumper skids and the beams forming the overhead also are of this same I-beam material. Providing additional supporting strength at the center of the lower unit is a center column of 7⅝-inch, 29-pound casing which is welded into place between the base and overhead beams. Covering for the generator house, including top plate, ends and most of the siding, is of 3/16-inch steel plate. Other parts of the siding, such as the doors, are covered with 14-gauge sheet. Interior floor decking is of the conventional diamond non-skid plate. Ample cross ventilation and accessibility to the generating equipment are provided for the generator house section. On one side of the compartment is an 11-foot wide sliding door, the center section of which is screened, and on the other side is a top-hinged door which, when opened, forms a canopy that provides shade or protection from rain. Access to the tool house is by a single sliding door on one side of the unit. Windows provide ample ventilation and light for the tool house.

The mud tank is of similar basic

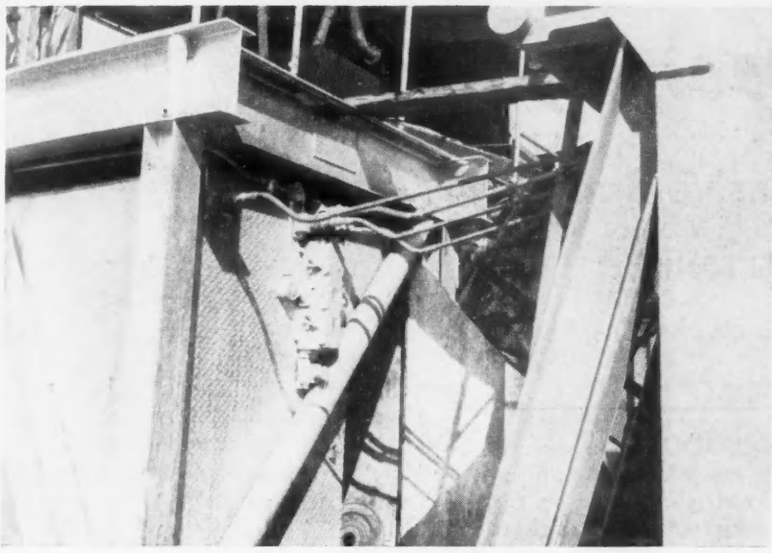


FIGURE 2. Unitized electrical connections between the generator house at right and the drilling rig at left deliver power to the rig when rigging-up operations are in progress.

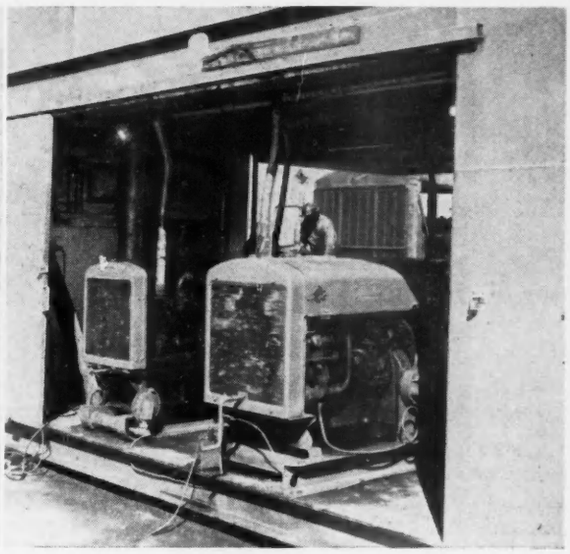


FIGURE 3. Individual exhaust lines for engines, shown suspended from generator house ceiling, conduct fumes to outside. Tool house occupies space at left end.

construction. Base members are of slightly lighter material, consisting of three 6x6, 20-pound I-beams. The bottom, siding and ends are of 3/16-inch plate and the interior of the tank is X-braced at several points with 3½x3½x⅜-inch angle iron. Similar angle material is used to strengthen the bottom of the tank, lengths being welded laterally, on 36-inch centers, along the under-side of the tank. The vertical ribs visible in the photograph, and which lend additional strength to the tank sides, are lengths of 2½x2½x ⅜-inch angle iron. These are welded to the tank side at 36-inch intervals and on the ends at 27-inch intervals. The angle forming the rim or top edge of the tank is of 3½x3½x⅜-inch material.

The tank is equipped with a 6⅝-inch suction outlet, an overflow line and cleanout valve. Ladder rungs are welded on the inside of one end of the tank and outside ladders are provided at the ends of both the tank and generator unit. The ladders on the generator unit are designed to be laid back against the tank when that unit is being transported. When the units are set up at the rig site, a U-shaped arm (visible in Figure 1), attached to the end of the tank immediately behind the ladder, can be lifted and hooked into eyes on the back side of the ladder in order to hold the latter out at the proper angle.

One end of the generator house unit, that closer to the rig, is partitioned off to form a tool house and general supply room. The walls are lined with steel bins and shelving of various dimensions, ranging from 32 inches wide by 18 inches deep to some having openings measuring 12x12 inches. Supports for the shelves are of the cantilever type which result in maximum space for storage of fittings and tools.

Shelving material generally is of 11-gauge steel sheeting. A steel closet occupies a part of one end of the room and a steel work bench is mounted across the other end.

Several other features which lend still greater utility value to the combined units are shown in the accompanying photographs. In Figure 2 can be seen the manner in which the electrical conduit is connected between the generator unit (right) and the drilling rig. Each connection, equipped with quickly-attached, weather-proof plugs, consists of a length of solid conduit to each end of which is attached a length of flexible material. When the units are to be hauled to the next location, the plugs are detached and the conduit allowed to drop, after which the several pieces are bundled together and lashed back against the siding of the generator house where they will be safe from injury when the units are being transported. Only a few minutes are required, when the units are being set up at the next location, to have electric power available on the rig, eliminating the necessity of stringing lines, making necessary repairs, rigging new connections, etc.

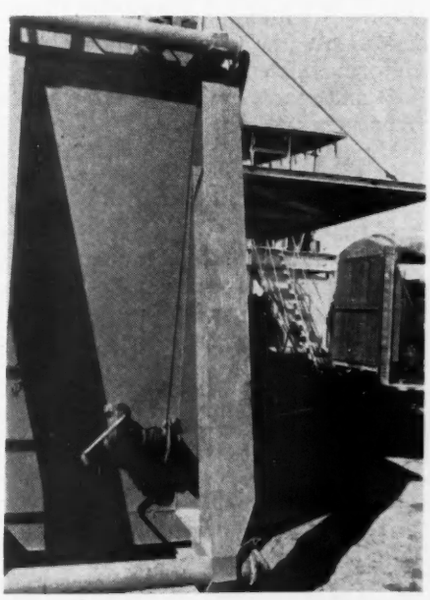


FIGURE 4. The large canopy, partly visible at right, is easily raised and lowered by this quarter-ton hoist mounted on the end of the generator house unit.

Partly visible in Figure 3 is the method employed for keeping the generator house interior bright, clean, and free of noxious fumes. The interior walls are painted aluminum to utilize to the maximum both interior and outdoor light. Exhaust from the generator units is brought up, first, through flexible lines, then into individual, fixed exhaust pipes suspended from the ceiling. Both lines exhaust to the outside at one end of the generator house unit.

To simplify the raising and lowering of the wide canopy on one side of the generator house, a small one-quarter-ton hand hoist is mounted on the end of that unit. Shown in Figure 4, the hoist line is run up through two light pulleys fastened to the upper edge of the mud tank and is rigged in such a way that the lower edge of the 12-foot wide door is raised horizontally. One man can easily raise the canopy, the worm gearing of the hoist providing ample gear reduction and being designed to reduce chances of the canopy falling when the hoist is unattended.

The general utility of the combination generator house and mud tank units is increased by the smaller features described, which contribute much toward reducing time and effort required for operation and servicing.

Pontoon Ferry

Eliminates Expensive Bridging Operation

By ELTON STERRETT

Engineering Editor

WHEN BRIDGING a river to move in equipment for an extension well threatened to run development costs too high to make the project advisable, equipment designed to meet the needs of World War II was modified to provide an economical and effective ferry on which the heaviest equipment could be handled, and which would prove 100 percent salvage in case of a dry hole.

EXTENSION of the South Liberty field, Liberty County, Texas, westward across the Trinity River bed and into bottomland under as much as ten feet of water during flood periods posed a rig transportation problem to Housh Drilling Company, Houston.

With a range of around 18 feet between normal low water and flood level conditions, any bridge to span the river not only would require vertical clearances to allow use of the stream at all stages, but also would require sufficient bracing to enable it to withstand the surge of debris-laden flood waters. Estimates on bridging the stream ranged upward from twice the estimated cost of drilling the projected 9500-foot test to several times that amount, the alternative being the construction of a levee roadway from Highway 90, which crosses the bottoms about 2½ miles above the well location. Since this latter would involve not only the construction of a high fill to insure an all-weather roadbed, but also the construction of several bridges or trestles across channels intersecting the bottoms, the problem of delivering rig, equipment and supplies to the well site was solved most economically by installing a ferry across the river at a point directly opposite the location. High banks at both ferry ends simplified the approach roads, and afforded adequate anchorage for the cables required.

Actual construction of the ferry and approaches was sublet by Housh to a subsidiary, Portable Bridge and Equipment Company, Houston, which undertook the grading of the roadway, and installation of the steel-shod "pavement" as well as the float or ferryboat.

Both approaches were graded to a uniform slope of 12 feet in 100, requiring approximately 160 feet of the steel roadway on either bank. Board road was tied in to each approach above the high-water line.

The ferryboat or float was formed by assembling a series of eight 33-foot army-type pontoons to give a structure 96 feet in length. Across this were laid parallel articulated tread sections, each with 45½ inches clearence between guard rails to accommodate dual tires and all gauges of truck equipment.

The tread sections were extended out over the outermost pontoons, and equipped with suspended heavy timber shock or contact sections. By regulating the length of tread overhang and position of the timber, it was impossible for even a most heavily loaded pontoon to come into contact with the steel roadway, which was laid so as to extend out into the water and provide secure gripping surface even under lowest anticipated river level conditions. As the approach grade was uniform, this contacting angle of the float and roadway was the same at all river stages.

Hinged flaps or approach ramps were attached to the ends of the tread sections and lowered to contact the steel roadway after the float had been anchored with safety or snubbing chains to maintain the desired contact. The articulated tread sections held their position against the approach roadway as a load was driven into position for ferrying, yet allowed the overhanging ends to lift slightly as the load reached the center of the float, eliminating difficulty in pulling away from the bank with a load.

The ferryboat was powered with a nine-horsepower, air-cooled engine, driving through an automobile-type transmission to a two-drum hoist or winch set. Cable from one bank was wound onto one drum, while cable reeled off the other at a similar rate. By applying power to one drum and braking the other, the ferry could be angled to bring the bumper timber into full cross contact with the roadway. As a further safeguard, a cable was stretched across the river just above the line of travel of the float, with safety lines from each end attached to a pair of snatch blocks which traverse the stream with each passage of the ferry. In the event of breakdown of the ferryboat's motive power during transit, the float could be maneuvered to a landing by slacking the trailing line or taking up on the lead line, and thus applying some of the power in the river current to the propulsion of the float.

With a span of roadway on the floats of 96 feet, it is possible to transport two trucks or tractor-trailer combinations at one trip, though the usual practice with loaded automotive equipment is to take one heavy unit at a time, along with any light units such as pickup trucks which may be ready to cross.

To provide means of communication across the stream, so that the float can be summoned regardless of its location with respect to the load, a two-station telephone was installed, with the instruments located on high ground out of reach of floods.

The 33-foot pontoons, brought in on trucks and assembled at the river bank, carry air pressure at two pounds per square inch in each of their eight air cells, and are so buoyant that the draft with a boiler hauling unit and boiler is only about six inches more than when light.

The ferry not only will serve the drilling of the well on the location now under development, but also further exploration or extension of the field until the volume of production justifies the expense of constructing a permanent river crossing or the access road down the high ground and across the channels between the area and the nearest present highway. Should the area prove non-productive, the entire ferry is 100 percent salvageable, the only unrecoverable portion of the job being the cost of grading the two approaches.

FIGURE 1 (above). The pontoon float or ferry, traversing the Trinity River light, seems almost to float on the surface of the water and to cause only a slight ripple in its passage. The unit can operate where there is less than two feet of water in the stream.

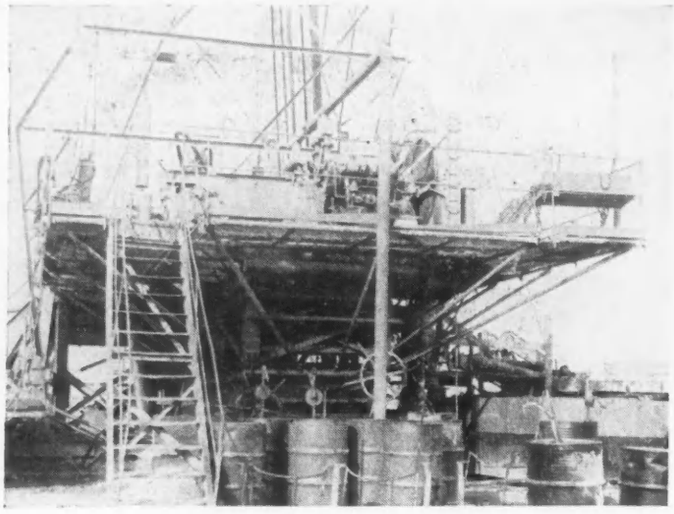
FIGURE 2 (above right). Loading a tractor and boiler-carrying unit calls for teamwork as one man, between the treads, signals steering directions to the driver so as to insure proper spotting of the dual tires on the fabricated, articulated treadways.

FIGURE 3 (right). In midstream, with a load of more than 40 tons, the ferry sits a scant six inches lower in the water than when crossing light, and is readily maneuverable. The treadways will accommodate two trucks or tractor-trailer combinations, but rarely carry more than one when fully loaded.

FIGURE 4. Discharging a load, the ferry is pulled against the steel-shod roadway, with the heavy buffer timber, visible at the right of the treadway, resting solidly on the roadway and forming shoreward support. The hinged "flaps" for connecting treadway with roadway, eliminate the need for timber blocking.

FIGURE 5. The power unit of the ferryboat is this 9 horsepower engine, driving a double-drum winch through automobile transmission. A single pedal controls clutches on both drums, while individual brakes maintain desired tension on pay-off cable.

Substructure Design Reduces Rigging Time



Santa Maria Drilling Company rig at Long Beach, Calif.

By

JOHN C. ALBRIGHT

Consultant

THE AUTHOR describes details in the construction of substructure and working walkways which not only facilitate setup or removal, but which also add to the ease with which the entire rig can be skidded where location and terrain permit. Pin and bolt connections between members speed work of crew and avoid extra charge for welder.

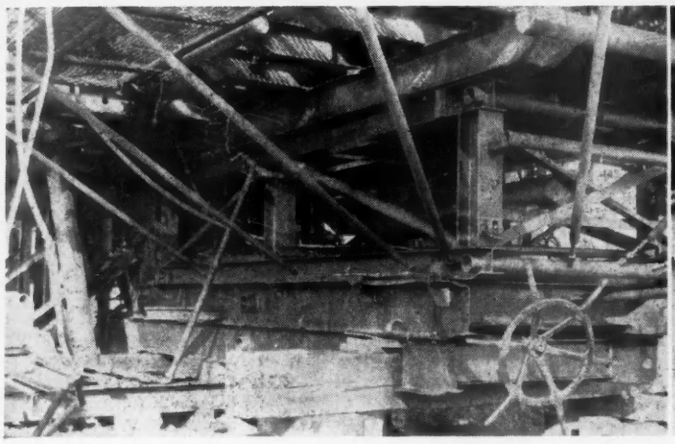
SANTA Maria Drilling Company, currently operating two rotary rigs in the Long Beach Harbor area, has developed a substructure for the engines and drawworks that has proved to be an asset by its contribution to the reduction of moving time.

The substructure is built in three separate parts: the lower base, an intermediate rectangular steel frame and a substantial skid member upon which the drilling engines and the drawworks are mounted. Added to this unit is a complete set of walks which are hinged to the skid members of the drilling engines, as well as the sides of the drawworks, and which are supported at the outer sides with diagonal, adjustable braces made of heavy tubing.

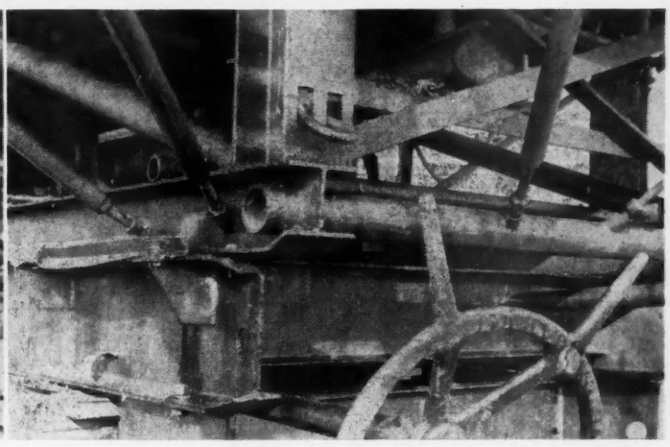
The lower part of the substructure is in two parts, usually left together, but which can be disassembled by removing the tie-in bolts. The bottom half of this part of the structure is of heavy structural 'I' beams having end connecting cross members bolted in place, instead of attaching by welding. Bolts are used so that repairs and replacements may be made in the field without recourse to a welder except for minor cuts and tacking work. The steel has wide flanges so as to rest securely upon a concrete slab, timber mats, or the conventional cribbing. Cribbing is commonly employed between the ground surface and the substructure so that minor adjustments for height can be easily made. Wide slots are cut in the side sills of this part of the lower section to set down on rig timber. The slots prevent the timber from slipping and they likewise prevent longitudinal movement of the substructure. The lower flange and all of the web are removed to leave the upper flange to connect both sections of the main sills. The only part requiring welding is a cross member of four-inch drill pipe inserted horizontally through both main sills and tacked to further stabilize the structure. Both the lower and immediate upper parts of this section of the substructure have formed ends so they may be easily skidded with a rigging truck when necessary to move them together or separately.

The center part, which is the rectangular frame, is also made of structural steel, braced with heavy 'I' beams and a center longitudinal sill, and stiffened with diagonal braces made of extra heavy tubing. The two lower side sills are finished by upturning the flange of the beam to form a runner for skidding with the assistance of heavy eyes inserted in the vertical standards at the end for attaching a towing cable. The rectangular frame is mounted directly upon the double base and retained in position with machine bolts placed at intervals through the matching flanges of the structural steel sills. The top part of the substructure is a long skid section with the end flanges turned up and connected by welding a six-inch drill pipe nipple between them. It rests directly upon the rectangular frame and is secured in place with machine bolts. Engine and drawworks skid members rest directly upon the top section and are retained in position with bolted clamps and holddown turnbuckles.

The walks are made by building separate frames of heavy tubing, each walk frame requiring three longitudinal parts tied together at the ends and at adequate intermediate points with similar material. Surfacing is expanded metal with diamond-shaped openings securely welded along each side member of the frame and at each point of the metal where it is trimmed to the required length. The walk sections are hinged to the engine and



Engine and drawworks substructure of Santa Maria Drilling Company rig.

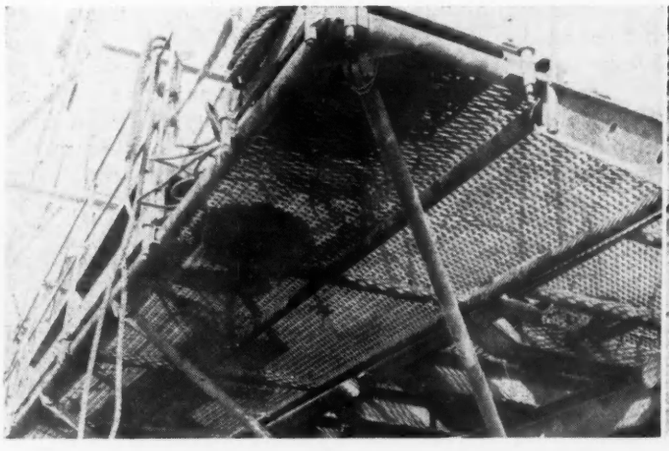


Method of connecting diagonal walk braces to the substructure.

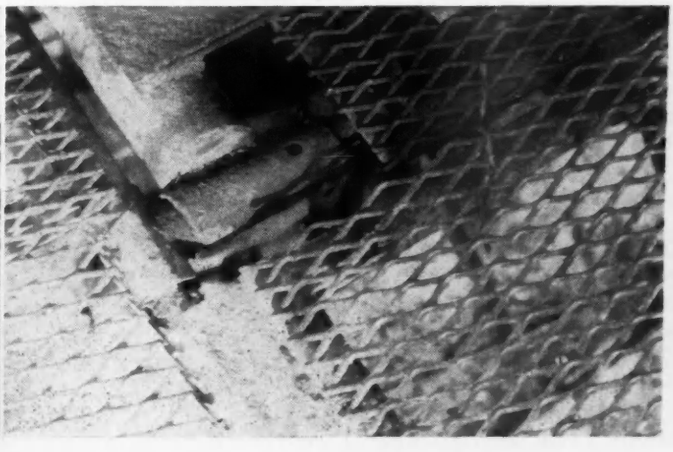
drawworks skid members, and to the end of the substructure. The hinges are made by slipping a short pipe nipple of the size larger than the side members of the frame on the side next to the substructure before the frames are completed. Stub nipples welded to these ferrules slip into similar ferrules attached to the skid members of the engines. These stub nipples are retained in place by safety bolts so they cannot vibrate out of position nor can they be removed without unlocking the safety wire. This type of hinge permits vertical movement of the walk sections, so they may be elevated, or dropped down beside the substructure as desired.

Supports for the outer sides of the walk frames are made of tubing. Connection with the walk frame is with a simple hinge made of flat steel welded to the rail of the walk along the sides, and to diagonal gusset placed at the corners. The second part of the hinge is an eye-bolt inserted in the tubing and securely welded. The lower ends of the diagonal braces are finished by inserting a smaller diameter nipple into which a one-inch threaded bolt is inserted. Shallow pockets are welded to the substructure in the side and end sills of the rectangular steel frame into which the rounded ends of the one-inch bolts are placed. A hex nut tacked near the pocket end of the bolts is used when making adjustments for length of the supports. The adjustment is locked with a second free running hex nut which matches against the open end of the diagonal brace. Safety rails around the walks are made in the usual manner by inserting vertical posts in ferrules at desired points along the outer sides. The walks can be removed entirely and with little time consumption by removing the diagonal braces and unlocking the safeties on the hinge pipe ferrules.

When skidding the rig from one location to another nearby, as practiced in the Harbor area of Long Beach, the entire substructure unit is disconnected from the derrick and raised higher with hydraulic jacks so house-moving trucks can be placed beneath the unit. The walk sections are commonly left in place as they offer no obstruction for men working and therefore are ready for use as soon as the structure is again set down upon the cribbing. If obstructions are encountered in the line of moving, the diagonal braces are removed, which permits each walk section to be lowered against the side of the substructure. The derrick is commonly moved on wheels so that as soon as it is located and set down, the substructure can be skidded in place, or rolled on the house-mover's trucks ready to be connected as soon as the timber mats for the derrick are in place. Frequently moving of less than one-half mile has been done with a down time of less than ten hours. Most of the time saved is credited to the flexibility of the rig and the design which permits the engines and drawworks to remain in position without disconnecting anything but the utilities.



Method of attaching upper ends of braces to the walk sections.



Hinge and retaining ferrule on side member of walk.

Reverse Circulating

Of Drill-Stem Tests in Open Hole

By J. E. SMITH

Johnston Oil Field Service Corporation, Houston

THE AUTHOR discusses a new method for reverse circulating out the fluid recovered in the drill pipe while taking a drill-stem test under normal open-hole conditions. The method allows fluid recovered to be displaced at the formation and recovered at the surface without pollution and removes the hazard in pulling a wet string of pipe after a test.

IN RECENT years service companies, drilling contractors and operating companies have expended considerable effort on the elimination of pulling a string of drill pipe from the hole when filled with live oil. The removal of a wet string of drill pipe does constitute a fire hazard as well as contribute to adverse working conditions for the drilling crew.

For several years numerous devices for reverse circulating out the fluid have been tried and used with some degree of success. The most widely used of these devices has been the pumpout plug.

The pumpout plug is usually mounted in a sub that may be inserted at any desired point in the drill string. The plug is removed by applying pressure inside the drill pipe in excess of the pressure of the hydrostatic head in the annulus. The pressure required to remove the plug varies widely and is somewhat erratic when the pipe contains live oil and gas. This condition is caused by the compressibility of the gassy column of fluid. The pumps on the drilling rig sometimes fail to put up enough pressure to remove the plug and it then becomes necessary to call out high pressure pumping equipment, which causes loss of rig time and additional expense. Another major objection to the pumpout plug is the necessity of pumping mud in the drill pipe on top of the fluid recovered on the test. This practice results in excessive pollution and in some instances seriously interferes with the interpretation and evaluation of the test and of the zone being tested.

The latest method of reverse circulating is through a valve that does two jobs; first, it takes a positive shutin pressure of the formation being tested; second, it provides a positive method of pumping through the drill pipe either forward or reverse. (The valve is referred to as a combination shutin pressure reverse circulating valve.) This valve may be inserted at any point in the testing string, and the fluid above pumped out and that below retained, uncontaminated by drilling mud.

Figure 1 is a schematic drawing of the open hole tester with packer set and the drill-stem test being taken. The arrows indicate the entrance of fluid from the formation through the perforated anchor E below packer D. The traverse of the fluid is through the valves of the tester which are all in an open position to the drill pipe above.

Figure 2 is of the tester assembly, showing packer D released, retaining valve C closed, and the combination shutin pressure reverse circulating valve A in open circulating position. The arrows indicate the entrance of drilling fluid through the circulating ports into the drill pipe from the annulus.

Part B of Figure 2 represents one or more joints of drill pipe that may be inserted between circulating valve A and retaining valve C to trap and retain an uncontaminated sample of the bottom hole fluid for examination upon removal of the drill pipe and tester from the hole.

The mechanical operation of the shutin pressure reverse circulating valve is simple and positive. It is operated by rotating the drill pipe to the right. The rotating load is carried on ball bearings to minimize torque in the drill pipe and provides free and easy operation of the valve. The mechanical arrangement allows one or a combination of several operating procedures to be used.

The most widely used procedure is as follows: At the conclusion of the flow period, the drill pipe is rotated by the rotary table six turns to the right to take a shutin pressure of the formation being tested. In this operation the production ports are retracted into a packing fluid, shutting off the flow of fluid from the test zone into the drill pipe. At the conclusion of the shutin period, the drill pipe is picked up and the packer released and removed from the packer seat. Retaining valve C in Figure 2 automatically closes. The mud pump is started and allowed to circulate drilling mud into the hole through the fillup line. The anchor E below packer D is allowed to remain in contact with the bottom of the hole. A small amount of weight is applied, usually one to two points on a standard weight indicator. The drill pipe is then rotated five additional turns to the right.

At the conclusion of these turns the production ports of the shutin pressure reverse circulating valve are positioned opposite the ports to the annulus and allow the fluid from the annulus to enter the drill pipe, part A, Figure 2. As the drilling fluid from the annulus enters the drill pipe the fluid recovered on the test is lifted to the surface. The annulus is kept filled by the pumps through the fillup line. The flow of recovered fluid from the drill pipe is through the high pressure flow head and through a choke. The choke at the surface allows control over the rate of flow and eliminates surging. The recovery may be diverted into a tank or burning pit in accordance with the operator's preference. The flow of drilling fluid continues from the annulus to the drill pipe until equalization of pressure is reached. At this point the blowout preventer is closed and pump pressure

For Economical, Dependable Rotation of Your Drilling String

USE AMERICAN IRON

Hex or Square

KELLYS!

HEX KELLYS

American Iron Hex Kellys are made from *fully heat treated* alloy steel forgings for longer wear and greater resistance to torsional stresses. Driving surfaces are machine finished—and circulation holes precision bored—for smoother running and proper balance at all drilling speeds. Our manufacturing processes and scientific inspection insure straightness, joint alignment, concentricity of bore, hardness and precision threaded connections.

SQUARE KELLYS

American Iron Square Kellys are also made from a heat treated one piece alloy steel forging with top and bottom integral upset ends formed during the forging operation. The radius on the square of the driving surface is correctly formed during the forging operation. Correct forging processes plus straightness, joint alignment, concentricity of bore, hardness and precision threaded connections, make the American Iron Square Kelly the best balanced square kelly available.

BALANCED FOR SMOOTH RUNNING at all drilling speeds

AMERICAN IRON & MACHINE WORKS CO.
MANUFACTURERS OF OIL FIELD EQUIPMENT
A
REG. U.S. PAT. OFF.
OKLAHOMA CITY U.S.A.

AMERICAN IRON & MACHINE WORKS CO.
Oklahoma City, Oklahoma • Box 1177 • Phone L. D. 518
District Office: Houston, Texas
Export Office: 11 West 42nd St., New York City, N. Y.

applied to the annulus to pump out the remaining fluid and gas or oil cut mud that is present in the drill pipe. The amount of oil or gas cut mud is usually one to two barrels.

When operating in open hole the pump pressure is held to a minimum to keep the fluid moving. This is a precautionary measure against breaking down the exposed formation. In most instances when reverse circulating in open hole the pump pressure is held below 300 pounds per square inch.

An extensive study of the entrance of the fluid from the annulus into the drill pipe was made to determine the velocity at which the fluid entered the drill pipe and the accompanying turbulence in the annulus at the point of entrance. The basis of this study was the taking of pressure measurements at the point of entrance of fluid from the annulus. These pressure measurements provided the measured differentials in pressure that existed just prior to the opening of the reversing valve, as well as a graphic record of the change in pressure differentials as the pressures in the drill pipe and annulus reached equilibrium.

From this study it was determined that the velocity of the fluid entering the drill pipe from the annulus is controlled to the extent that the turbulence in the annulus was minor, and not of sufficient force to disturb the wall cake or mud sheath on the wall of the hole.

The conclusions drawn from observation of actual operations and the study of these data indicate the following:

- Practicability of reverse circulating out the fluid recovered on drill-stem test in open hole. There is no hazard except in areas where extreme difficulty has been experienced with loss of circulation. There is a relatively small percentage of wells drilled where the increase in pressure of the hydrostatic head of 200 to 250 pounds will cause the breakdown of exposed formation.
- Interpretation of the results of the non-flowing drill-stem test is improved by pumping out the recovery. A more accurate measurement of actual fluid recovered is possible by pumping into a tank if one is available, or by taking a measurement of the mud that is required to complete the filling up of the drill pipe. The difference between the capacity of the drill pipe and the number of barrels required to push the recovered fluid to the surface determines the actual number of barrels recovered on the drill stem test.
- Economically, there is a considerable saving in rig time required to make the test. By displacing the fluid recovered on the test, the drill pipe is pulled from the hole dry in the same manner as when pulling a bit. The pollution of expensive drilling mud is also eliminated.

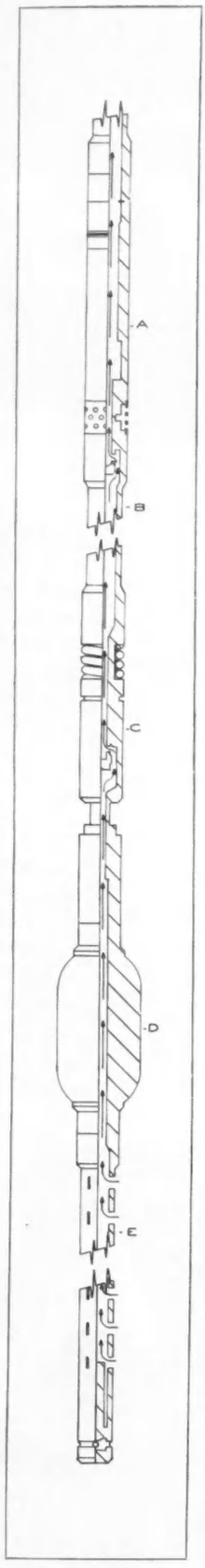


FIGURE 1

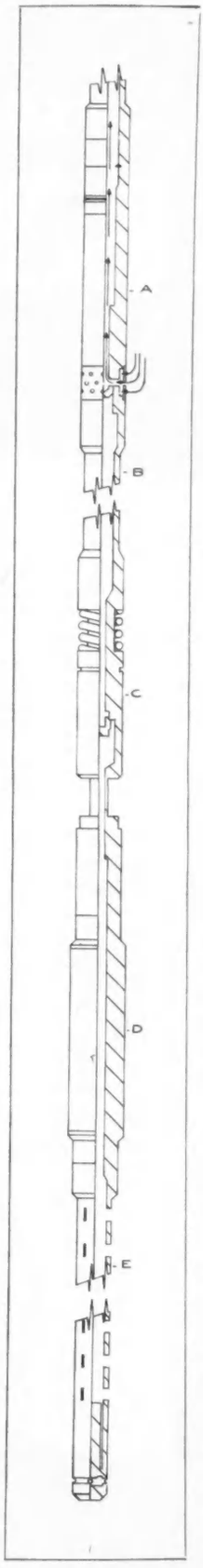


FIGURE 2

Drilling Safety Factors Cited

W. W. Duncan, Safety Director, Loffland Brothers, before a safety clinic of the American Association of Oilwell Drilling Contractors reported in part:

"For many years we have depended on our insurance carriers' engineering department to carry on the safety program, but due to the wide spread of our operations in many cases it was inadequate in its scope.

"The Safety department was set up by top management, and is considered a part of management, dealing only with safety matters, as there is no dividing line. Insurance and personnel are very closely associated with the Safety department pertaining to overlapping activities.

"The program was started by the safety engineer going into the field and visiting all rigs and operations, thus getting acquainted with the field supervisory personnel and convincing them that the entire program is set up to help them in their operations by making the job safer and increasing production by using safe work practices which in time have resulted in increased efficiency of the men.

"All new employes are required to pass a pre-employment physical examination and all field personnel must have hard hats and safe-toed shoes before going to work.

"Rig meetings are held with each crew once a month, conducted by the toolpusher, and with all personnel taking part. Safety suggestions are asked for and consideration given to all received.

"Toolpushers' meetings are held once each month by field superintendents and all accidents are analyzed and the prevention of recurrence of the same type of accident discussed. Description of the preventive measure is sent out to be put into effect by all toolpushers of the district.

"Rig safety inspections are conducted monthly on each rig, using AAODC rig safety inspection blanks. These inspections are the responsibility of the toolpusher. In some cases the daylight driller makes the inspection and is checked by the toolpusher.

"All protective equipment necessary in different areas is furnished by the company and the men are trained in its use. Where special equipment is necessary, as in the gas areas, regular training programs are held in 'Care and Use of Gas Masks.'"

Baash-Ross News

BAASH-ROSS TOOL COMPANY • LOS ANGELES • HOUSTON • OKLAHOMA CITY • NEW YORK

OUR 31st YEAR

You buy just 1 block ... It does the work of 3

For those small block jobs, here's the most sensible investment you can make–

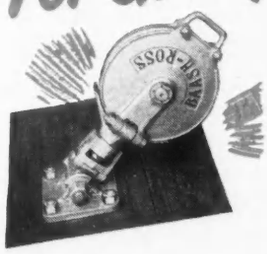
The BAASH-ROSS UNIVERSAL UTILITY BLOCK

Although in average drilling and producing operations there are dozens of different jobs that call for small blocks, you can reduce them all into three principal types of work . . .

1. **Bending lines around corners, such as in snatch-block applications.**
2. **Supporting lines in the rig for lifting tools and equipment.**
3. **Small traveling block applications for reducing line loads during hoisting operations.**

And the Baash-Ross Universal Utility Block is unique in that, simply by changing inexpensive accessory units, this *one* block will handle any of these *three* types of jobs. What's more, its capacity is 39 tons with 2 to 1 safety factor!

For example...



FLOOR BLOCK: Simply attach a base plate and you have a Floor Block that can be used with portable pulling outfits in well servicing work. Positive stops allow the Block to tilt 45° in any direction and a roller bearing swivel allows it to follow the line freely as it spools on and off the drum. To save time, in moving the Block from rig to rig, you can anchor an inexpensive base plate on each rig floor and quickly mount the Utility Block by inserting just one anchor bolt between plate and Block.

CORING BLOCK: When you need a small block in the crown for handling bailing and coring lines, simply attach a beam hanger unit to the Utility Block, fasten the beam hanger to a crown beam and you're ready to roll.

The hanger can be placed at any convenient point on the crown beam and when tightened, will not slip. The full-swiveling and tilting features permit the Utility Block to follow the line freely, minimizing wear on both line and sheave.

TUBING BLOCK: Fasten a tubing block clevis and your Utility Block is ready to serve as a Tubing Block in a wide range of well servicing applications. The clevis is free to swing from side to side and is also free to rotate . . . or can be locked against rotation by means of a built-in pin. The heavy-duty tapered roller bearing on the sheave gives the unit a high working capacity.

HEAVY DUTY *Performance Features*

Three-way adaptability is only part of the story on the Utility Block. Look at these top quality construction features . . .

- Side opening feature (by simply removing one bolt) saves time in placing lines around the sheave.
- Capacity 78,000 lbs.—with 2 to 1 safety factor.
- Sheave is alloy steel, 18" dia.—with flame-hardened groove 14½" dia.
- Bearings in both sheave and swivel are heavy-duty tapered roller type.
- Full 360° swiveling in all applications—or swivel may be locked by built-in pin.
- High pressure grease ducts direct to sheave and swivel bearings.
- Rope cannot jump sheave—guarded by side plates.

The Baash-Ross Universal Utility Block makes important savings on small-block inventories and it is available grooved for any line from ⅜" through 1".

AVAILABLE THROUGH LEADING SUPPLY STORES

Coddle That Cathead!

By BEN. F. KELLEY

THE drilling rig cathead is constantly in use during drilling operations and so requires as much care and attention as the drilling engine. Cathead design and development have come a long way since the days when four-men crews were more extensively used and the driller was compelled to leave the controls to do the catheading, an operation which not infrequently resulted in serious or fatal accidents.

Late in 1936 the first spinning cathead was put into service. Since then the spinning cathead has been steadily developed until it is a fine piece of equipment. Another development is the friction safety breakout cathead, the use of which is widespread and which has cut down on accidents as well as reduced insurance costs to drilling contractors. Besides boosting the safety factor, modern catheads result in reduction of line wear.

The functions of the spinning cathead are to spin up and tighten drill pipe or casing; that of the breakout cathead is to break drill joints. Catheads are made up of steel, cast iron and highly developed friction facings and are equipped with roller and ball bearings specially designed for the equipment.

Primarily, proper care and maintenance of catheads involves good lubrication practices. The spinner spool should be lubricated with a good grade of SAE 40 motor oil which should be applied in the center of the spinner spool after removing the two plugs which protect the lube ducts. If the spinner spool is in continuous operation while drilling it should receive a good squirt from the lube can at least once a day or the equivalent of 24 hours of operating service. If the shaft is idle while drilling, the spinner requires a lesser quantity of lubrication unless more than normal numbers of trips are being made.

Cathead clutch ball bearings require attention and should be greased with a good quality grease, similar to that used on automobile front wheel bearings. The grease should be applied at the three grease connections provided, with one full stroke of the grease gun in each cup once a week, or for the equivalent of once in 24 hours of continuous operation, or once every two weeks when the shaft is idle.

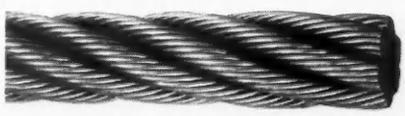
The housing at the outer end of the cathead near the cathead line spool should be greased each trip, or at each greasing period around the rig if the shaft runs continuously.

The cathead is an integral part of a drilling rig but can cause serious injuries and even death if carelessly operated. Improperly or carelessly handled, a cathead can result in fouled up lines which grab at arms or legs or become twisted around the neck, jerking and dragging the victim into the air and/or against other moving parts of the rigs. This type of accident frequently results fatally and cathead manufacturers have designed the equipment to eliminate such hazards so far as possible. However, crews must maintain constant vigilance at all times during catheading operations.

Following the development of the friction cathead, accidents were still being reported while catheading over the derrick, picking up large loads from the derrick floor, and in similar lifting operations. Such accidents are almost invariably due to the catline spool being grooved deeply adjoining the spool flange, or because badly frayed line was being used. This practice causes the second wrap to be drawn under the first wrap thus fouling the line. This hazard has been greatly minimized by the development of the non-foul catline spool guard which is becoming standard equipment on all drilling rigs.

Form-Set Wire Rope

now costs very little more than the non-preformed type



Unseized Form-Set rope. Not a single wire has become unlaid after cutting. This absence of wildness makes Form-Set easy to handle.

Another demonstration of "no wildness." A strand and one of its wires have been lifted out of place; the others lie undisturbed. There are no inner forces to make the rope touchy.

We want *everybody* to know that Bethlehem Form-Set rope (preformed) is now almost as low in price as the conventional, non-preformed kind. We want everybody to know that the advantages of Form-Set rope are available at so little extra cost.

What *are* these advantages? Here's what thousands of users have found:

★ Form-Set rope has little or no internal tension . . . because the wires and strands are preformed, given their permanent shape, before being laid in the rope. Hence the wires have no urge to spring apart, even when cut.

★ This absence of tension means that the rope has high resistance to bending fatigue. It lasts longer on applications where bending fatigue is a serious factor.

★ Absence of tension also means better spooling, far less kinking.

These are a few of the major points, and they are important. Many, many users have always considered Form-Set rope an excellent investment, even at the old price differential. Now it costs so little more than non-preformed rope that it suits almost everybody's pocketbook.

If you haven't been quoted on Form-Set recently, ask for details today. Then try a reel. You'll find we aren't talking through our hats!

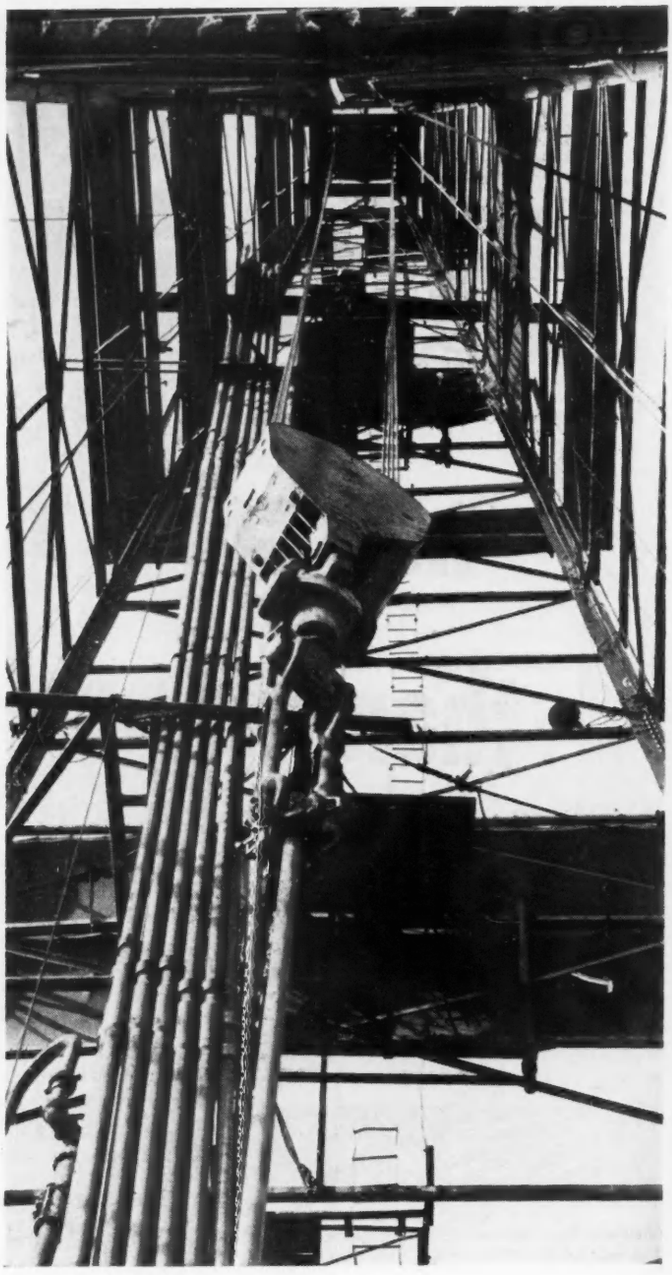
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

When you think WIRE ROPE... think BETHLEHEM

Care And Maintenance of Wire Rope



By R. D. McNUTT
Senior District Sales Manager, American Chain & Cable Company, Houston

WIRE rope is used every hour of the day, lifting and placing equipment. Everything that is lifted or hoisted in the oil field has the potential of an accident connected with it.

Keeping this thought in mind, it is not safe to use second hand or discarded wire rope except in very exceptional cases. There is no way to know what the condition is of an old discarded piece of wire rope. It may not have 50 percent of its original strength due to internal rust and other factors.

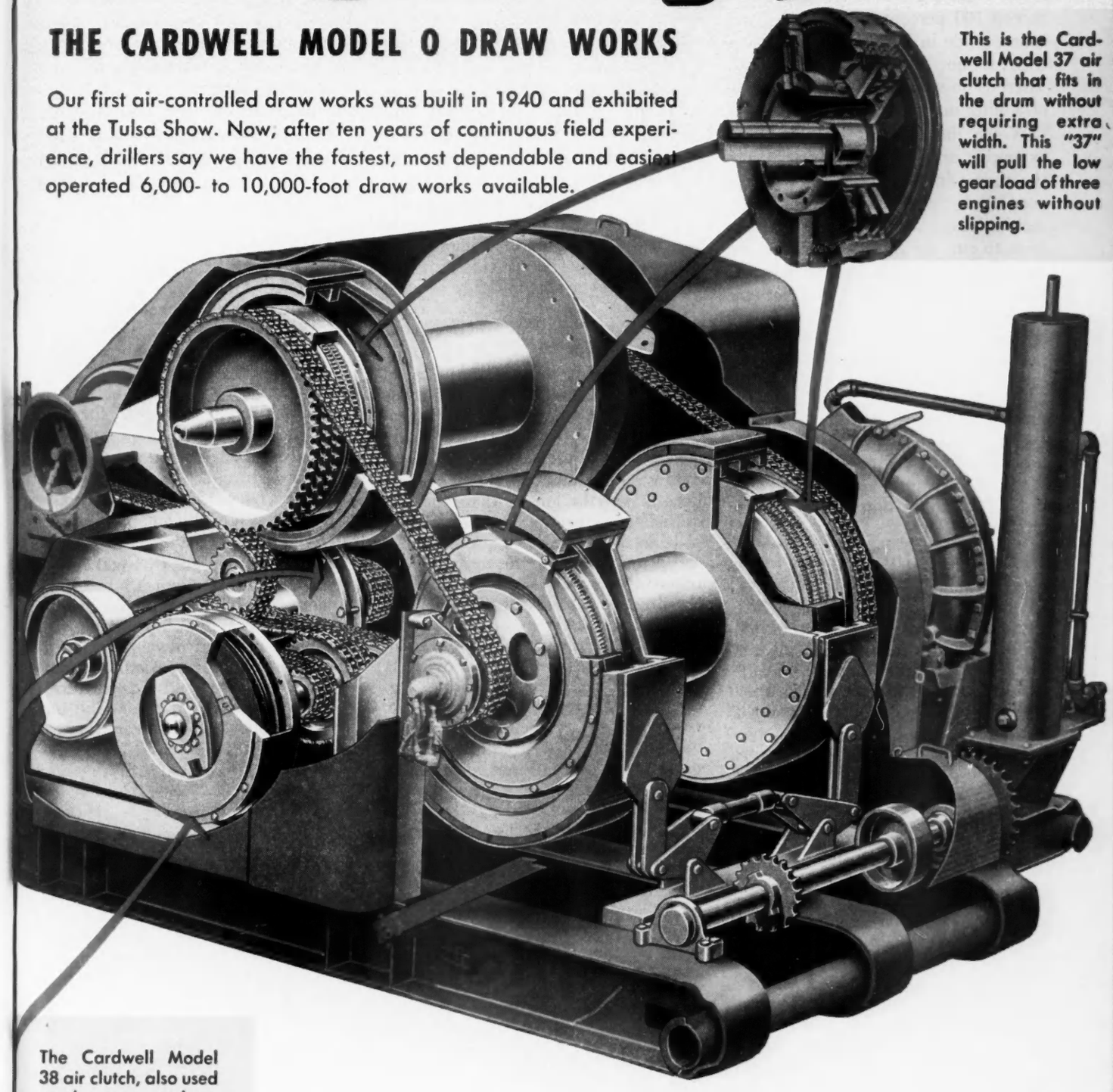
It would be desirable to consider standardizing on a simple set of factory-made slings for each rig to be used in lifting and placing heavy equipment. As an illustration, a simple sling could be designed and made to handle a blowout preventer, and at the same time this sling might be used for other purposes. Such a set of standard slings would not be expensive and would help eliminate accidents.

The railroad companies do this. They have every wrecker and shop equipped with a specific set of standard factory-made wire rope slings, blueprinted and catalogued for the specific job they are to do. The oil industry would find it advantageous to do likewise, particularly from the standpoint of safety. The equipment and machinery are just as standard

Simplicity Plus

THE CARDWELL MODEL O DRAW WORKS

Our first air-controlled draw works was built in 1940 and exhibited at the Tulsa Show. Now, after ten years of continuous field experience, drillers say we have the fastest, most dependable and easiest operated 6,000- to 10,000-foot draw works available.



This is the Cardwell Model 37 air clutch that fits in the drum without requiring extra width. This "37" will pull the low gear load of three engines without slipping.

The Cardwell Model 38 air clutch, also used on the pump and rotary table drives . . . is already famous for NO FAILURE, NO ADJUSTMENT AND LONG LIFE WITHOUT REPAIRS.

Note the H-Beam foundation, the compact engine power take-off, the availability of sand line drum and hydromatic brake. The drum chain assembly and cathead shaft may be idle while the rotary table is operating, thereby reducing wear. The Cardwell "Air-Flex" clutches are field proved on 30 rigs without a single failure. The Cardwell "Air Disc" drum clutches have been used in the Model O and Cardwell "Trailerig" since 1947. These are the only friction clutches available that can be mounted in the drum without increasing the rig width, and still provide greatest line pull without slipping. Every wearing part of every assembly in this rig is heat-treated to give maximum service life. That's why Cardwell rigs are known throughout the world as "Tough Iron."

CARDWELL MFG. CO. INC.

Wichita, Kansas, U.S.A.

as that which the railroads handle.

Factory-made slings are recommended because the splice for the loops, etc., is proof tested and guaranteed 100 percent efficient. A hand splice, made in the field, or one using clips is not 100 percent efficient. There is no way to know the strength of a sling made on the job.

Winch line failures are sometimes expensive and cause accidents. From the time winch line tail chains have been used, the standard means of attaching same to the winch line has been to run the line through the last link and tie a knot in it. This damages the rope through distortion of the strands, thereby reducing the strength of the rope at that point up to 50 percent. There is a means of attaching or detaching the tail chain to the winch line and the assembly is 100 percent efficient. The truck drivers may find some objections to this, preferring to continue using the old method of tying a knot in the rope, but an assembly that is 100 percent efficient is safer.

Rotary Drilling Lines

Much money is invested in drilling a well; and in addition, the lives of men are literally hanging on your drilling line. A lot of money is invested in the best equipment available. It goes without saying that the drilling line should be the best that money will buy. Most wire rope manufacturers make and recommend preformed rope for rotary drilling lines. It has established itself as a better all-around rope and is safer to use.

When a new line is strung up it has a sufficiently high factor of safety. This varies with the depth of the well and the number of lines. It is recommended that the safety factor shall not be less than 3.5. It is important that everything possible be done to maintain a sufficiently high factor of safety throughout the life of the rope.

If the factor of safety is to be high, the line must wear evenly and smoothly with no noticeable bad spots or extremely worn sections. In a 6 x 19 rope there are 114 individual wires, not counting the center. One wire might be defective at one spot, but from this standpoint, it is actually impossible for the line to have had a bad "spot" or faulty section in it originally.

These bad spots and extremely worn sections develop as a result of the operation after the line has been placed in service. These so-called bad spots and extremely worn sections originally were identical in every respect to all other parts of the line. But, regardless, when a bad spot or extremely worn section develops, the safety factor has dropped in proportion to how bad this spot or section is.

What causes these so-called bad spots and worn sections and how can they be prevented? Assuming a rope is of the correct specification and sheaves are in good condition and grooved correctly for the rope, there is only one answer for the bad spots and extremely worn sections.

The line has been run too long in one position without changing the points of wear. The critical points are at the crossover on the drum, the fast line in the reaving system, and the dead line at the point where it contacts the sheave.

The only way to prevent these bad sections ever developing in the line is to change the points of wear by regularly cutting off at the drum and keep pulling through good rope.

Most operators purchase drilling lines in lengths longer than that required to string up, for the purpose of being able to make regular cuts at the drum and pull through, thereby removing possible crushed sections on the drum and changing the points of wear in the blocks.

A practice of making regular cuts will help maintain the factor of safety and assure far greater service out of the rope. There is a direct ratio between the safety factor and service, and the regularity of cuts at the drum. If regular cuts are made at the right times bad spots and extremely worn sections will not develop. It is doubtful if a drilling line would ever part or pull in two if a practice of making reasonably regular cuts is carried out.

Following is an excerpt from a report on a line that developed an extremely worn section and as a result probably became unsafe:

> "This line drilled two 5200-foot wells and made over 50 trips, but was not cut off. It drilled another well to 6800 feet and a fourth well to 4923 feet."

This line should have been cut several times while doing all this work. A report was recently received on a similar line where no cuts were made and the line fell in two while going in the hole with only 4000 feet of pipe hanging on it. All manufacturers get similar reports too frequently from those who run the line too long before making a cut.

The thing to decide is how often cuts should be made and how many feet should be cut off at each cut. It takes time to make these cuts and no hole is being made while doing this job. It might be possible to cut down on the time to do this job by having a permanent five-eighth or three-fourth-inch line attached to the crown on which the traveling block can be swung. It takes thirty minutes or more to swing the block while getting ready to cut and pull through.

A survey made to find out what practices are being followed revealed that they can roughly be classified into four groups as follows:

1. A large percentage buys just enough rope to string up and make no cuts. This group buys lengths ranging from 900 feet up to 1550 feet in multiples of 50. This group's wire rope costs undoubtedly run high, and the safety factor is probably very low while making the last few round trips with the line.
2. Another group buys enough extra rope to enable them to make from two to six cuts. This group buys lengths from 1550 to 2000 feet in multiples of 50. The cuts range from 20 to 150 feet each.
3. Others buy lengths that will enable them to make from 10 to 30 or more cuts. This group buys lengths ranging from 2000 up to 7500 feet usually, but not always, in multiples of 200. Here again the cuts range from 20 to 150 feet each. It often happens that those who buy extra rope fail to make the cut until too late. It often often happens here that 500 feet or more has to be cut out of the line. In such a case you might as well have bought a shorter line in the first place.
4. Shift or move about 25 feet forward after each 500 ton miles of work. Shift three to four times and then cut from 75 to 100 feet.

Whose practice is best and most practical? Of course, the type and size of the rig as well as the field has something to do with this, but the length of lines and cutoff practices vary for rope used on the same equipment and in the same field. There must be some one length when used on a certain type rig in a particular field or area that is most economical to use—and if this is true, those who are buying lines too short are running wire rope costs higher than necessary.

By the same token those buying the long lines, but who fail to cut soon enough and then have to cut out 500 feet or more, are in such cases, running costs high. Of more importance,

■ CONTINUED ON PAGE 118

Engine Shelter Supports

Speed Disassembly

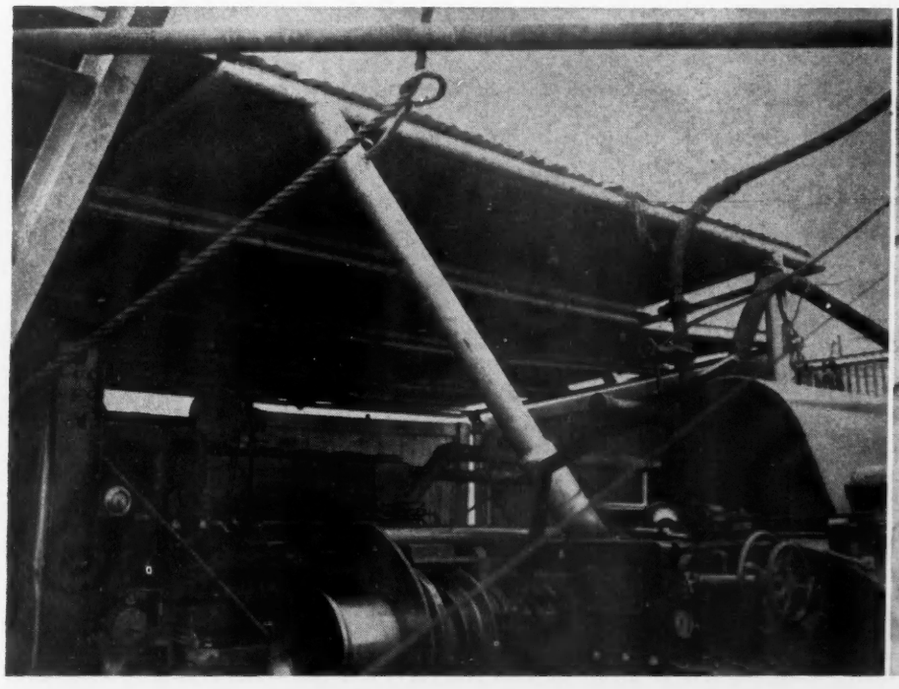
WITH HOURLY costs running high on the down time of a rig for rigging up and dismantling, any device which saves time becomes important. Here the author describes and pictures an effective and time-saving method for handling the portable roof over the drilling engine and drawworks.

UTILIZATION of a somewhat different method of supporting the awning structure over the engine and drawworks of a jackknife-type rig is bringing about substantial savings in rigging-up and tearing down costs for a drilling contractor operating in the West Texas area. The principal members of the support consist of four short lengths of drill pipe welded to the back side of the drawworks at the front end, and to the skid base and transmission case at the back end. Side wings of the awning structure, attached by hinges, can be lowered when the rig is moved. Corner post supports for the side wings, being of unusually practical design, permit the wings to be released quickly and easily.

The awning itself is built in conventional fashion, being made up of several panels of galvanized corrugated iron nailed to planks bolted to the sloping, all-welded framework of two-inch pipe. The main panel, that part which covers engines and drawworks and which can be allowed to remain in place when the rig is moved short distances, is supported by short posts of 4½-inch drill pipe. These posts, set at angles of approximately 45 degrees, give what amounts to four-point support but without the disadvantage of having the posts rest on the derrick floor where they would take up, or at least break up, valuable floor space at each end of the drawworks. On the front side (Figure 1) these posts are set on the back portion of the drawworks frame. Each of the posts, approximately five feet long, includes a pin and box tool joint connection, the latter being welded to the drawworks framework. The tool joint connection makes it possible to have a single sturdy support for the awning but has the added advantage of providing a means of breaking it free at that point when necessary, leaving only a short section of the post still attached to the drawworks.

The rear supports are installed in a similar fashion except that they are mounted on whatever pieces of equipment happen to be conveniently located and which are sturdy enough to provide a solid base. In this particular instance, illustrated in Figure 2, one of the legs was welded to the end of the engine skid base and the other to the sloping rear end of the transmission case.

At the point of contact with the roof structure, the post ends are cut out so as to provide saddles in which the two-inch pipe awning side frames of the roof section can be rested. At each of these points, a bolt, run



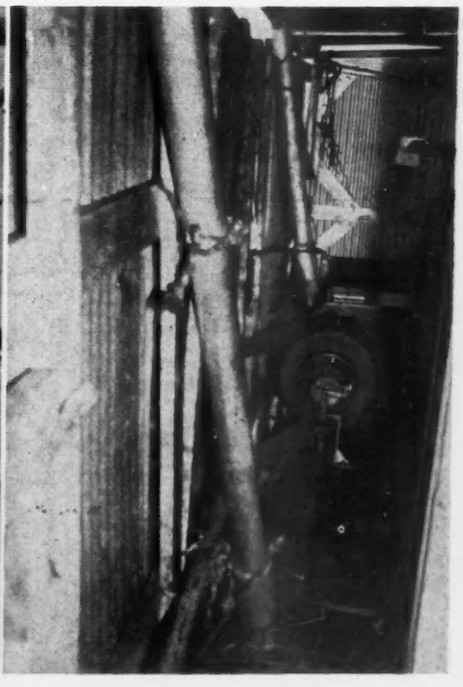


FIGURE 1 (left). Two short lengths of drill pipe, including a tool joint connection at the lower end of each, form the support for the front end of the main awning. One half of the pin-and-box connection is welded permanently to the back of the drawworks. When necessary to remove the awning and transport it separately, the posts can be unscrewed and laid down. A single bolt ties the awning framework to a clip welded to the upper end of each post.

FIGURE 2 (right). At the rear of the engine area, the awning is supported by two more posts set at an angle similar to the front posts except that they are welded to the engine base and back side of the transmission case.

Features that fit

The Amazing New

GREEN TRIANGLE Rotary Hose

On the largest mast-type rigs . . . in the deepest fields of the Southwest . . . under the extreme pressures of the latest pumps—these are the rugged drilling conditions that rotary hose must be prepared to meet today. And these are precisely the conditions that have dictated the development of the great new Green Triangle hose . . . that have brought about rotary hose features unique to oil-field operations.

Green Triangle (3-Band)—first premium rotary hose with all these advantages

Highest Working Pressures—designed to handle the extreme operating pressures of today's most modern rigs and drilling methods.

True-Balance Construction—4 plies of high tensile steel wire provide greater resistance to highest pressures with maximum flexibility. This true balance of strength, flexibility and durability permits installation with all types of drilling derricks.

Trouble-Free Operation—proved consistently safe and dependable by two rugged test years on offshore, barge, deep hole, high pressure and wildcat drilling rigs—assuring substantial "down-time" savings.

Green Triangle (2-Band)—the new cable hose with these fine features

Cable-Wire Construction—applied under machine-controlled tension, two plies of high tensile "non-rotating" cable wire assure a true-balanced construction for perfect performance.

Greater Flexibility — "non-rotating" cable wire combined with a pliant but powerfully strong fabric carcass, live-rubber cushioned, guarantees a longer life of increased flexibility . . . in a hose that hangs naturally in perfect balance without distortion.

Versatility—powerful enough for large standard drilling rigs—yet its extreme flexibility provides proper drape on small narrow base or jackknife derricks.

COUPLINGS—all Green Triangle Rotary Hose furnished with full hole, streamlined, built-in couplings.

CONTACT your nearest Continental Oil Field Store for complete information about these amazing new hoses . . . for helpful on-the-job service.

CONTINENTAL

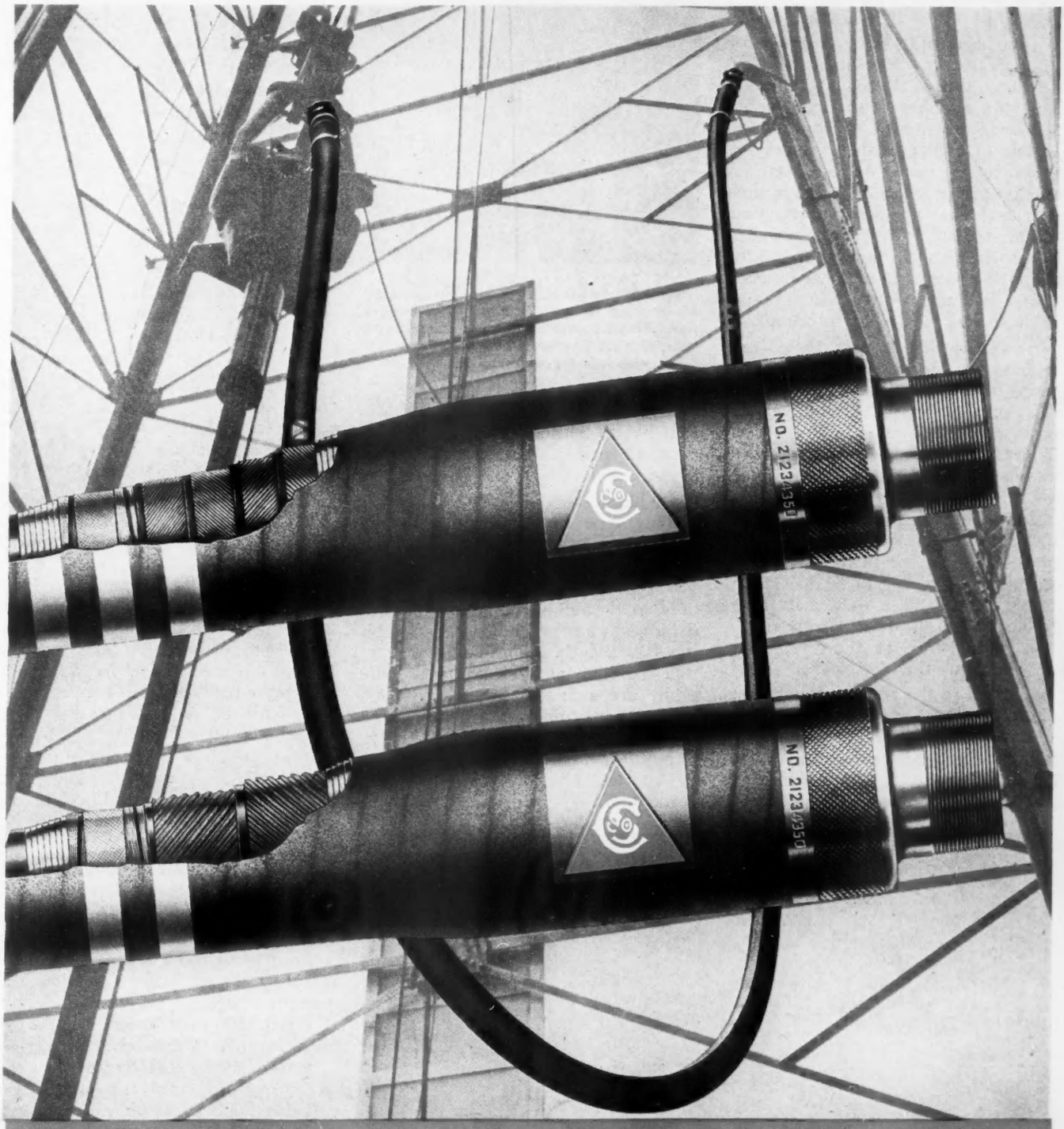
The Continental Supply Company, General Offices: Dallas, Texas

The Continental Supply Company, Limited, 216 Lancaster Building, Calgary, Alberta

***Export Division:* The Continental Supply Co., Inc., 30 Rockefeller Plaza, New York, N. Y.**

REPRESENTATIVES: Argentina • Bolivia • Brazil • Chile • England • Ecuador • Peru • Trinidad • Uruguay • Venezuela

today's toughest service



SERVING THE OIL AND GAS INDUSTRIES WITH PRODUCTS OF

NEW YORK BELTING & PACKING COMPANY

PASSAIC, NEW JERSEY

through the two-inch pipe, is extended down through a heavy steel clip welded to the upper surface of the drill pipe several inches from the upper end of that member. Tightening these anchor bolts provides a rigid connection which cannot be shaken loose or blown off by a high wind.

The side wings, which are seven to eight feet wide, are of a construction similar to that of the main roof panel. They are attached to the main panel at three points by sturdy hinges. Visible in Figure 3, these hinges are shop-made of heavy flat bar material and are positioned and welded in such a manner that the wing frame abuts the main awning side frame when in the horizontal position and can be dropped down to a vertical position ready for transporting after engine exhaust lines have been broken off.

At the outside corners, these wing sections are supported by a novel rotating shelf which is positioned atop each of the three-inch pipe vertical posts. One of these supports, shown in detail in Figure 4, illustrates the manner in which the rotating support is operated. A short sleeve having an inside diameter slightly greater than the outside diameter of the post, is placed over the end of the post where it rests upon a ring of similar diameter which has been welded in place. A short piece of steel plate having a hole burned through the center of it is welded to the side of the sleeve.

Rotated to the position shown, this plate affords a shelf on which the edge of the wing frame can rest. A bolt run through both members securely holds the wing frame in place and prevents the sleeve from rotating.

FIGURE 3. Side wings, seven to eight feet wide, are attached to the main awning by means of sturdy hinges positioned to bring the adjoining frame sections to contact each other when the wing is in the horizontal position.

When the wing is to be lowered, all that has to be done is to remove the bolt and rotate the sleeve through 90 degrees, after which the wing is free to be lowered.

This type of awning support is economical to construct and is one which can be adapted to practically any type of rig, it being necessary only to decide which points on the drawworks and engine bases would be most suitable for mounting of the drill pipe posts. Materials required generally are available in the company salvage yard and a comparatively small amount of burning and welding is required to adapt the supports to the particular type of awning framework that might be employed.

FIGURE 4. Side wings can be dropped easily and quickly through the use of sleeve device installed on the three-inch corner post. Following removal of the tie bolt, the sleeve, and with it the small shelf on which the awning framework rests, is rotated through 90 degrees, permitting the wing to be dropped.

Wire Rope Care

▪ CONTINUED FROM PAGE 112

when a line has been run in one position until 500 feet in the blocks is bad, it is doubtful whether the line is safe.

Since there is such a wide variety of opinions as to the practice that is best, a further study of this subject might cover the following:

- How often should cuts be made between certain specified depths and how many feet should be cut out at each cut?
- How should the formula for cuts vary with respect to the weight of the drill pipe and the number of drill collars?
- Consider the advisability of making a cut of a certain number of feet after a certain number of ton miles have accumulated since last cut.
- What length line should be purchased in order to be able to make a certain number of cuts of a certain number of feet each during the life of the line?

As an illustration, this study might reveal that for drilling in 8000-foot fields using a certain type rig with a 136-foot derrick and stringing eight lines, that 2500 feet is the line to buy. It would take about 1550 feet to string eight lines. This would leave 950 feet to be used up in making cuts. If each cut averages 50 feet it would be possible to cut 19 times. From that, work out when each should be made.

For a range of deeper depths, and based on an anticipated number of round trips per well, study might reveal that 5000 feet is the length to buy and start out with.

- What precautions should be used at all times to insure safety?
- In conclusion, the following is suggested as a guide.

From grass roots to 3500 feet make a cut of 25 to 50 feet or after the twelfth trip.

From 3500 to 5000 feet make a cut of 50 feet after each eight round trips.

From 5000 to 8000 feet make a cut of 50 feet after each six round trips.

From 8000 to 10,000 feet make a cut of 50 feet after each five round trips.

From 10,000 to 12,000 feet make a cut of 50 feet after each four round trips.

Below 12,000 feet make a cut of 50 feet after each three round trips.

After deciding on the practice to follow in a given field of certain drilling conditions, records should automatically reflect that the line should be cut before making another trip.

2590 *extra barrels every month for 6½ years*

with

BLACK MAGIC

OIL BASE DRILLING FLUID

On October 10, 1940, the first Specific Productivity Index was .00611. On April 11, 1947, 6½ years later (the date of the last reading), the SPI was .00132. It had dropped to 21% of its original pressure. Total production during this 78 month period was 256,000 bbls., an average of 3285 bbls. a month.

The first SPI taken on September 24, 1940, was .00789. On August 19, 1947, the SPI was .00294. In 83 months it had declined to 37% of its original. Total production was 487,500 bbls., a monthly average of 5875 bbls., an increase of 2590 bbls. every month over Well A.

These two offsets, drilled on a California lease in 1940 by a major oil company, were similar in every detail. They were drilled to the same reservoir within a few hundred yards of each other. Their logs and cores showed a close relationship from top to bottom. Only on one known factor did they differ: Well A was completed with a water base mud while Well B was completed with an oil base mud.*

NOTE THE SIMILARITY OF THESE OFFSET WELLS

	WELL A	WELL B
Sand Thickness	180 ft.	190 ft.
Average Sand Permeability	115 md.	105 md.
Static Pressure	3135 psi	3100 psi
Millidarcy feet of sand	20,700	19,950

*The oil base mud used in this well contained air-blown asphalt and was mixed with a refined type oil. After several improvements this mud became known as Black Magic.

BLACK MAGIC ASSURES MAXIMUM RECOVERY

These wells were produced under proration conditions and represent normal depletion practices. In spite of the fact that Well A flowed an average of 3285 bbls. monthly, it still was producing far below its ultimate potential due to Jamin action (water blocking), the result of drilling into the production zone with water base muds. The difference in the size of Wells A and B proves beyond question that water blocking damages a well permanently, hastens the day it will be shut down.

Black Magic with a filtrate loss of zero cannot possibly mud off or water block the oil sands. Black Magic deposits a thin mud cake that readily disintegrates when displaced by crude. It helps instead of hinders production and on occasion has made commercial producers out of dry holes. For full information write for paper "What Happens Tomorrow?"

OBI PRODUCTS also include WHITE MAGIC oil emulsion mud; OB GEL to increase Black Magic viscosity; OB GEN to regenerate water-contaminated Black Magic; OB WATE weighting material; OB HEVYWATE, barites; CHEMICAL "V" regenerates crude contaminated Black Magic; CHEMICAL "X" reduces its viscosity; OB MIX FIX corrects a faulty mixing oil; OB ZERO lowers fluid loss; OB MUD GUNS; OIL BASE HAND CLEANER. Write for a free copy of the Oil Base, Inc. Handbook containing useful information on muds and drilling equipment.

OB PRODUCTS

OIL BASE, INC.

Main Office & Plant: 130 Oris St., Compton, Calif.

Houston Plant: 8200 Market St. Road, Houston, Texas

Branch Offices: Bakersfield, Long Beach, Ventura, Houston, Fort Worth, Corpus Christi, Oklahoma City, Midland, Worland

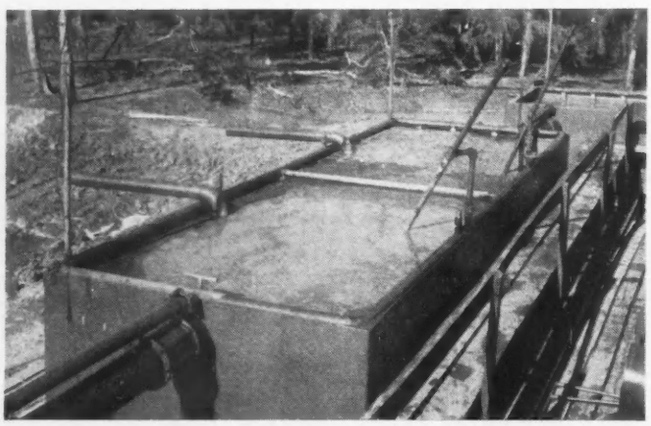
Export Offices: Elmer R. Smith, Caracas, Venezuela
G. Saavedra E. Hijos, S. De R. L. Mexico, D.F.

How to do it!

DRILLING HINTS

$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Reinforce Mud Tank Top with Fluid Header



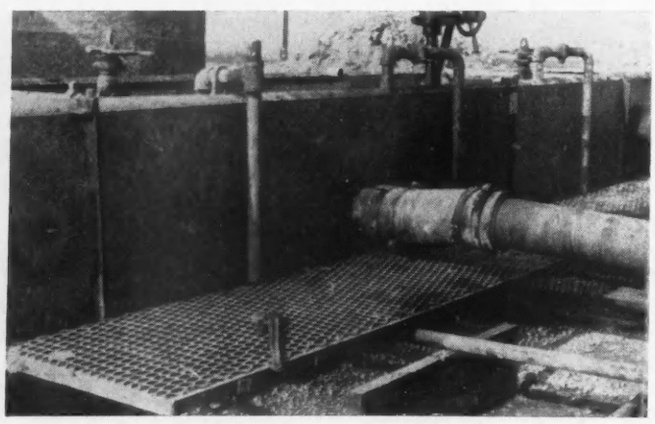
In constructing mud tanks, it is important to save as much space and weight as possible. One saving may be effected by running the lines for the mud guns around the tops of the mud tanks as shown.

The advantages are that the tank top is fully reinforced with a strong 4-inch line welded integrally with the tank and that the same support is used to carry the mud mixture to the mud guns. The guns are placed at a convenient position at the top edge of the tank near the walkway.

Connections are welded on both sides so that the guns can be mounted where most convenient. Tube turns are used to make the 90-degree turns around the corners, and boiler plate is used to fill in the space on the outside and inside of the angle to make the tank extra rigid for moving operations. Quick acting unions are placed on the edge of the tanks so that they can be disconnected at the same time that the main mud lines are broken out.

The two four-inch lines extending horizontally from the left edge of this metal tank are jet lines. The 90-degree ell in these lines connects with a vertical riser that extends down to the bottom where a smaller steam line is telescoped inside the larger pipe. When it is necessary to quickly discharge fluid from the pit, the steam jets are opened and the mud in the pit is dumped into the shale pit which is located alongside the mud tank. These jets eliminate drain valves commonly welded into the tank at the bottom, and which, in some instances, are sources of loading and handling difficulties due to the protruding connections.

HOW TO—Hang Metal Walkway on Elevated Mud Tank

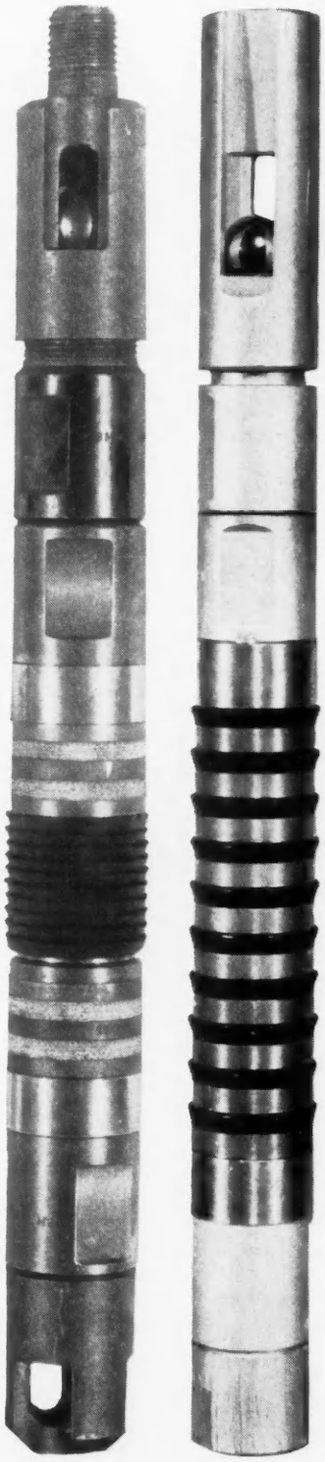


Attaching expanded-metal covered walks beside the metal mud tanks is done with hangers that require no fastening other than a hook at the top. Hooked hangers made of substantial angle iron have bearing pads welded to the lower end which press against the walls of the tank. A horizontal sill of angle iron welded to the lower end of the vertical-hooked hanger is finished at the outer end with an up-turned lip to prevent the walk from moving.

Walks are made in convenient sections with an angle iron frame having cross members to which the floor of diamond-shaped expanded metal is attached. Each barbed end of the metal is carefully tacked to the end section of the frame to prevent damage to shoes while in service and to men when moving the equipment into a location or tearing down after the well is completed. As many hangers are provided for the walk support as are necessary for the weight of the men who work upon it while mixing mud or changing flow of fluid at the guns. These hangers are of a length to place the floor of the walk at a convenient height for men working beside the mud suction tanks. The outer ends of the horizontal parts of the hangers may be cribbed in the usual manner, or supported by service piping.

This arrangement is substantial and also reduces rigging-up time since no bolted connections are required nor is welding necessary to attach the apparatus to the mud tanks.

WILSON "NO FRICTION" SUB SURFACE PUMP CUPS



For

—Longer Life

—Increased Production

Wilson "No-Friction" Sub-surface Pump Cups are setting new records on Low-Lifting Costs. Comparative tests have proven that pumps equipped with these cups have from two to three times longer life in "problem wells," than pumps equipped with other type plungers. Due to their unique design they allow no fluid slippage at even the lowest of pumping speeds. In many wells the use of Wilson "No-Friction" Pump Cups will actually increase daily fluid volumes.

The cups are so designed that each individual lip is free to exert the maximum wiping action on the inside surface of the working barrel. The fluid load on the cups is supported by the inside body of each cup.

The special synthetic rubber type compound used in the cups is highly resistant to abrasion and will withstand temperatures in excess of 350° F. It will also withstand the corrosive action of oil well brines and sour crudes. These cups will not harden with prolonged use under the most adverse pumping conditions.

Tests made in "sand" producing wells have proved that Wilson "No-Friction" Sub-surface Pump Cups will outlast other types.

For Complete Information Contact
Your Nearest Wilson Supply Store

WILSON SUPPLY COMPANY

BRANCH STORES

***Texas*—Alice, Corpus Christi, Victoria, Bay City, Columbus, Barbers Hill, Liberty, Beaumont, Kilgore, Monahans. *Louisiana*—Lake Charles, New Iberia, Houma, Harvey, Shreveport.**

1412 Maury St.
HOUSTON
TEXAS

Sales Offices:

DALLAS, TEXAS
TULSA, OKLAHOMA
NEW ORLEANS, LA.

"Better Built"
HINDERLITER
EQUIPMENT

CHECK YOUR NEEDS
AND ORDER NOW

Rotary Equipment
Tool Joints
Reverse Circulators
Pipe Wipers

Cable Tools
Drilling Bits
Fishing Tools

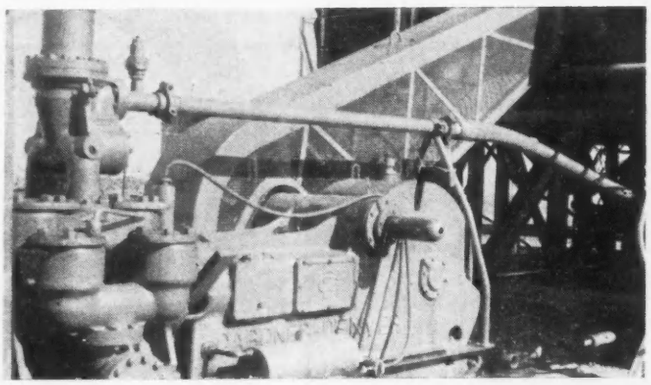
Well Head Equipment
Christmas Tree Assemblies
Casing Heads
Tubing Heads
Blowout Preventers
Casing Rings
Flanges

Valves
Porter Lubricated Plug Valves
Jarecki Valves and Cocks

Hinderliter manufacturing and service facilities are geared to meet your demands—just give us a trial

HINDERLITER
PORTER
"Better Built"
EQUIPMENT
HINDERLITER
TOOL COMPANY DIVISION
H. K. PORTER COMPANY, INC.
Tulsa 1, Oklahoma

HOW TO—Brace Flexible Mud Line



A mud pump discharge line supporting system employed by one West Texas drilling contractor combines both simplicity and freedom from scuffing commonly resulting from pump pulsations. As shown, the solid section of the mud line is supported at the back end of the pump by a pair of pipe legs bolted to the pump skid base members. A length of rotary hose connects at that point and extends over to the mud line attached to the rig substructure.

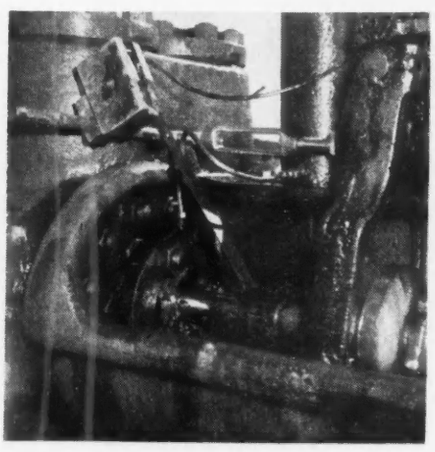
This method requires a minimum of breaking-out when the rig is moved, as only the flexible section of the line need be removed or laid back out of the way. The flexible section is kept off the ground where it might be in the way of workmen walking in the vicinity and where it would be subjected to wear where it contacted the ground or parts of the rig equipment.

HOW TO—Add Pump Stroke Counter

A simple means of counting the strokes of the mud pump at a remote point about the rig may be rigged electrically as illustrated. A two-conductor wire is strung from the mud laboratory or derrick floor to the mud pump and connected so that each time the circuit is grounded a counter at the other end of the cable is energized to register the number of strokes. The circuit is normally open, and contacts are closed only when a spring extension arm is depressed by the flange rod coupling between the fluid and steam ends of the pump.

The device is portable and is clamped between the valve boxes and the center of the pump. The spring which contacts the live circuit is arranged so that each travel of the piston grounds the connection. The contactors are mounted on a ¾-inch section of light-weight tubing bent at a right angle on one end. This short end is threaded and screwed into one end of a turnbuckle. The other end of the turnbuckle is attached to the rocker-arm housing. The turnbuckle provides a means of easily making minute adjustments on the position of the spring contactor to produce the best registration.

Also shown is a simple means of lubricating the pump packing. A 6-inch by 2-foot nipple with one end blanked off is fastened to the top of the pump bed and a hole is drilled and tapped on the top of the packing gland outside the packing. A sump tank is placed at a handy position on the base of the pump and each tour the 6-inch nipple is filled with lubricating oil. During the tour oil drips on the rod as it reciprocates in the packing gland clamp. Life of fluid end piston rods was materially increased, and the expense and upkeep of the lubricating device was found to be slight, since there are no working parts to wear.



FIRST CHOICE
Thermoid
Powerflex Rotary Hose
Tube—Synthetic rubber . . . abrasion and oil resistant . . . free circulation and long life assured.
Reinforcement—Steel cables and pre-stretched fabric for the greatest strength and flexibility.
Cover—Special vulcanized compound resists aging and abrasion.
Couplings—Streamlined steel . . . full flow built-in and anchored securely for the life of the hose.
It will pay you to Specify Thermoid!
EVERY LENGTH PRE-TESTED TO 5000 PSI BEFORE SHIPMENT
Also
TRIOFLEX
Slim-Hole Rotary Hose
for Portable Rigs, Seismograph and Workover Service. Tested to 2000 psi before shipment.
SEE OUR CATALOG IN THE COMPOSITE CATALOG

Thermoid Quality Oil Field Products: Oil Country Flat Belting • Wire Line Turn Backs • No-Wip Line Savers • Stuffing Box Rings • All types of Hose • Molded Specialties • Powerflex Rotary Hose • Mud-Flo Slush Pump Hose • Flexible Discharge Units • Brake Blocks • F. H. P. and Multiple V-Belts.

Thermoid Company

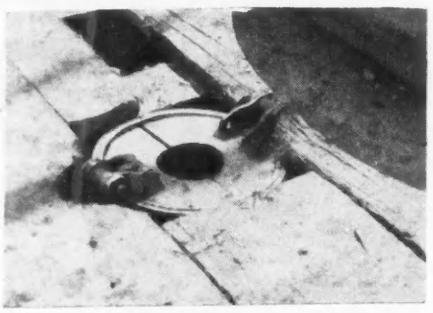
Western Offices and Factory • Nephi, Utah, U. S. A.
Mid-Continent Warehouse • Houston, Texas, U. S. A.
Main Offices and Factory • Trenton, N. J., U. S. A.
Industrial Rubber Products • Friction Materials • Oil Field Products

HOW TO—
Construct Hinged Lid for Mouse Hole

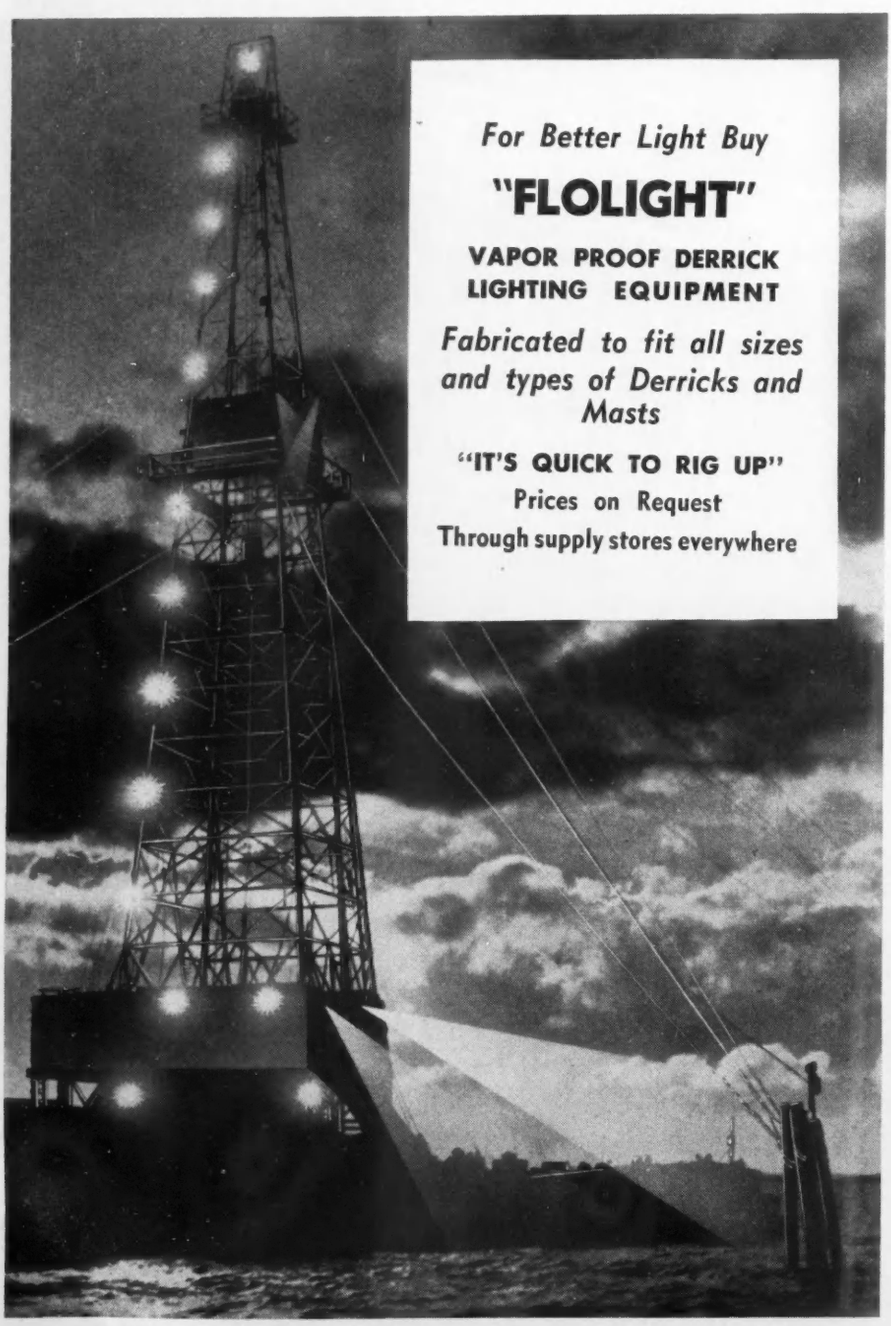
To keep the length of drill pipe centered and prevent it from being moved from one side of the hole to the other when the kelly is being stabbed, one drilling contractor uses a hinged plate device which covers the open space that ordinarily would be left between the pipe and the mouse hole casing.

A disc of ¼- or ⅜-inch steel plate, having a diameter equal to the inside diameter of the mouse hole pipe, and having a hole in its center equal in size to the outside diameter of the drill pipe, is cut in half and mounted inside the top of the pipe as shown.

Two sections of rotary chain form the sturdy hinges used. The two halves of the lid are easily flipped open by the derrick floor man when the joint is run in the mouse hole and as easily flipped back when the joint is centered in the hole. The lid opens



automatically when the drill pipe is pulled out. Such a device, which also serves to prevent hand tools or other objects from being dropped in the mouse hole, easily repays the slight cost of material and time required for its construction.

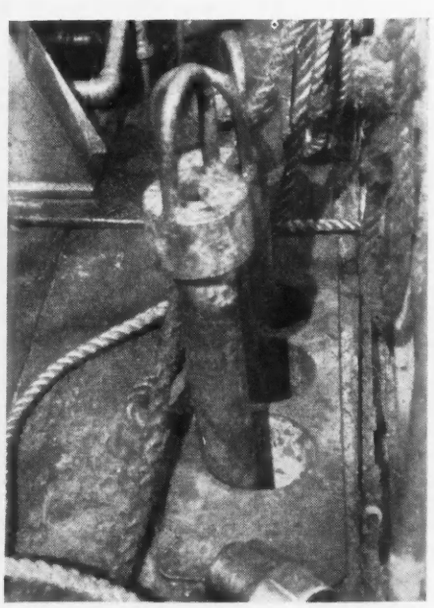

For Better Light Buy
"FLOLIGHT"
VAPOR PROOF DERRICK LIGHTING EQUIPMENT
Fabricated to fit all sizes and types of Derricks and Masts
"IT'S QUICK TO RIG UP"
Prices on Request
Through supply stores everywhere

HUTCHISON MANUFACTURING COMPANY
6609 AVENUE U, HOUSTON 11, TEXAS

HOW TO—
Build Flush-Mounted Lifting Sub Rack

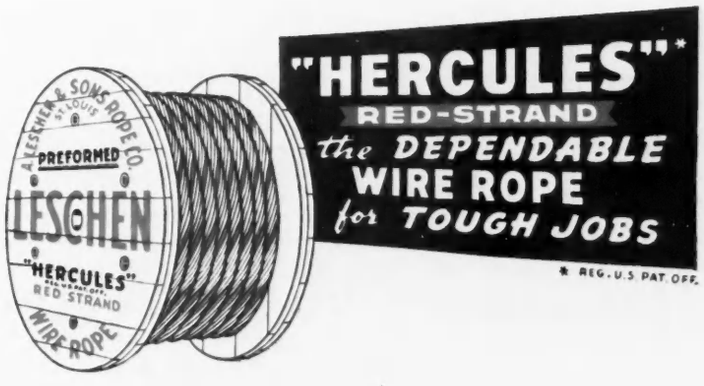
A convenient lifting sub rack, one which is mounted flush with the derrick floor, is found by one drilling company to have several advantages over the type commonly stood up and lashed to the railing or other convenient structural member.

Illustrated in use, this rack has a storage capacity of three subs. The individual holders are short lengths of eight-inch casing closed at the bottom and welded to the steel plate collar which rests upon the derrick floor. Positioned so the rack will span two floor joists or otherwise be supported beneath the floor, the rack need not be spiked down as its weight and that of the subs will hold it in position. Unlike some racks, this one requires no lashing back against the railing and there is no danger that the subs or rack will be accidentally knocked over in the course of handling other equipment.



Yes, Just a Piece of Wire BUT...

upon its quality and fabrication depends the kind of wire rope service you will get.



If this wire goes into a rope of the 6 x 19 Seale Construction with a fiber core, it will be just one of 114. But if it is a "HERCULES" (Red-Strand) Wire Rope, *every* one of the 114 wires will have been rigidly tested to make sure that it met, fully, our exacting standards as to *all* essential properties. Furthermore, the rope will have been designed and fabricated according to the most advanced methods of manufacture.

Only by the strict adherence to such principles can the highest quality in wire rope be produced — *consistently.* It is never a matter of chance.

Because of the exacting care and long experience always used in making "HERCULES" (Red-Strand) Wire Rope, you can depend on it for safe and economical service. As it is made in a wide range of construction — either Preformed or Non-Preformed, there is in this one grade, a "Right Rope" for any heavy duty job.

MADE ONLY BY

We Invite Your Inquiries

A. LESCHEN & SONS ROPE CO. 5909 KENNERLY AVE. • ST. LOUIS 12, MO.

ESTABLISHED 1857

New York 6 · Chicago 7 · Birmingham 6 · Houston 3 · Denver 2 · Los Angeles 21 · San Francisco 7 · Portland 9 · Seattle 4

SLASH . . .

DRILL COLLAR REPLACEMENT COSTS!

It will pay you many times over to investigate Lone Star's improved, automatic process of building up drill collars.

By shipping drill collars to the Lone Star plant for build-up, you profit 2 ways:

(1) You gain assurance of uniform, faultless workmanship which can be attained only at the plant . . .

(2) You pay less. Lone Star's process is materially faster, therefore less costly.

Write today for complete information.

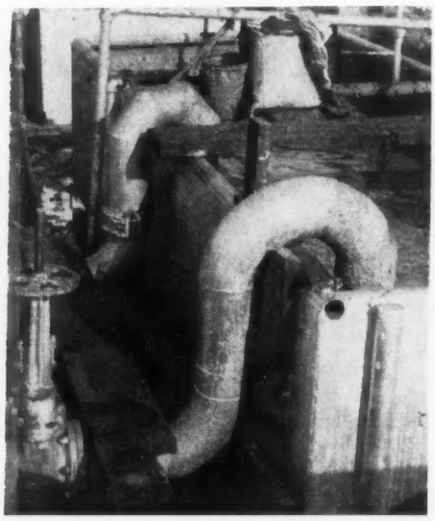
LONE STAR ★ TOOL COMPANY

WICHITA FALLS, TEXAS

HOW TO—Use Siphon Suction Pipe

Checking on the small details of a drilling rig to determine where changes might be made to cut down on rigging up time, one contractor decided to install siphon suction pipe for the mud pumps instead of the more or less conventional bolted flange connections and short hose couplings.

The siphon is made by using a conventional 90-degree ell welded to the companion flange of the suction control gate valve. The necessary length of pipe is welded to the top opening of the ell to bring the following fittings to the rim of the mud tank. A return bend, or 180-degree ell welded to the top of the pipe nipple, brings the siphon fittings well over inside the rail of the mud tank.

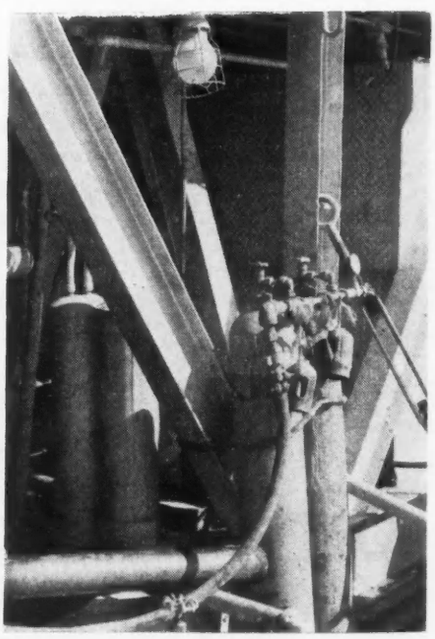


On the open end of the 180-degree ell, which looks downward, is a joint of pipe long enough to reach nearly to the floor of the mud tank for a flooded suction at all times. Two things are eliminated by the use of the siphon suction. One is the conventional flanged suction fitting in the side of the tank. The other is the necessity of an exact line-up of the mud tank with the pump suction line. The throat of the 180-degree ell is deep enough to permit deviation a few inches either way when the tank and the pumps are set ready to be operated.

HOW TO—Install Water Softener

Improved operation and generally reduced maintenance of certain pieces of equipment are resulting from the practice of one drilling contractor who keeps a supply of soft water in a special tank immediately below the rig floor. Soft water, circulated with a small centrifugal pump, is used in such equipment as the hydromatic type brake, drawworks brake drums and engine radiators. The soft water greatly reduces deposition of scale and provides more efficient cooling. In the case of the brake drums, particularly, the use of soft water pays for itself. When scale, formed by hard water, is deposited on the drums, cooling is greatly reduced for water is unable to come in direct contact with the drum surfaces. In addition, accumulations of such scale make it frequently necessary to get into the drums—a time consuming task in itself—to scrape off the scale. The water tank, a rectangular, all-welded container having a capacity of about 75 barrels, is mounted in the rig substructure.

Two softener tanks, stood up on a special mount in the substructure area beside the tank, are connected to the water system with flexible hoses. Water is soap-tested regularly to make sure the desired degree of softness is maintained. The storage tank is drained and the softener tanks changed every time the rig is moved from one location to another.



YOU CAN'T BEAT THIS GOODALL COMBINATION

The Finest, Strongest Rotary Hose That Money Can Buy PLUS A Maintenance Policy That Protects Your Investment For The Lifetime Of The Hose

THESE EXCLUSIVE FEATURES MAKE GOODALL LONG-LIFE FLEXIBLE CORD THE FINEST ROTARY HOSE BUILT: Cord Construction - Goodall's Flexible Cord Design provides the extra strength to withstand torsional twist . . . thus eliminating the cause of more than 90% of rotary hose failures; Flexibility - Goodall Long-Life can be coiled into a convenient unit for transporting without slightest damage; Perfect Balance - assured by the Goodall method of winding the multiple cords of the carcass and the steel cables of the pressure element at corresponding angles; No Premium Price - the extra quality and long-life of Goodall Rotary Hose costs no more than ordinary rotary hose.

THESE EXCLUSIVE GOODALL FEATURES PROTECT YOUR ROTARY HOSE INVESTMENT: Goodall Maintenance - Goodall maintenance provides a repair department in Houston where any length of Long-Life Flexible Cord that meets with an accident can be renewed for the rest of its normal life. Barney Couplings - the only couplings stronger than the hose itself. Barney Couplings have saved thousands of dollars of rotary hose from the scrap pile; Salvage Value - Substantial allowances are made on every set of Barney Couplings returned.

Why buy any other hose that does not give you this Goodall combination of extra long life with extra protection for your investment? Thanks.

Barney

GOODALL RUBBER COMPANY
TRENTON, N. J.

GOODALL RUBBER COMPANY OF TEXAS: Houston, Texas.
GOODALL RUBBER COMPANY OF CALIFORNIA: San Francisco, Los Angeles, Seattle, Salt Lake City.
GOODALL RUBBER COMPANY: New York, Philadelphia, Pittsburgh, Chicago, Denver, St. Paul.
EXPORT: Goodall Rubber Company, Trenton, N. J.
DISTRIBUTORS: Texas and Louisiana — Houston Oil Field Material Co.; Wilson Supply Co.
Oklahoma — Iverson Supply Co.

Goodall Has Been FIRST With Every Worthwhile Rotary Hose Development!

HOW TO—

Eliminate Standpipe On Workover Rigs

On workover rigs which must be moved often, the standpipe used to support the rotary hose may be eliminated by substituting a hose support provided by a traveling block attached to a guy wire.

As shown, an extra long section of rotary hose is used and the center of it is attached to a block which rides up and down an extra guy wire attached to the mid point of the mast.

When rigging up, it is necessary only to lay the discharge line from the mud pumps to a point half way out the guy wire and attach the rotary hose. A soft rope is used to tie the hose to the traveling block. As the drill pipe is raised and lowered, the block pulls the hose out of the way and keeps it from piling up on the derrick floor when the blocks are down.

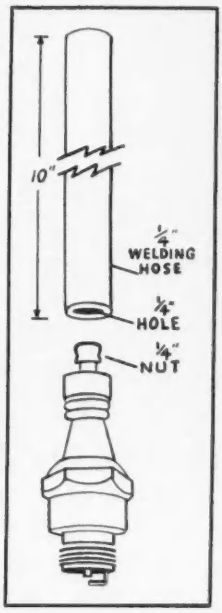
In tearing down, the guy wire and hose are kept together for simplified rigging up at the next location.

HOW TO—

Change Sparkplugs On Hot Engine

When it is necessary to change a sparkplug on an engine that has been running all day, the engine is hot and the mechanic must work very close to the manifold or over the engine head. This device is especially adapted to aid the mechanic in changing the plugs on engines where the plug is recessed far into the engine head.

It is not a hard job to remove the sparkplug with a special plug wrench which is easily fitted over the plug and



Free Your "Hands"

for other important work . . . use

GEOLOGRAPH

MECHANICAL WELL LOGGING SERVICE

Geolograph gives you accurate drilling time, guide for bit change, round trip time and shutdown time. Reduces number of failures in drill stem testing! This data — and more — you get with Geolograph — while, at the same time, it frees your "hands" for other important work!

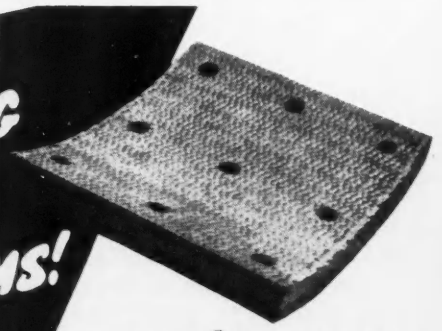
HOUSTON, ODESSA & WICHITA FALLS, TEX. • CASPER, WYO.
SHREVEPORT & BATON ROUGE, LA. • BAKERSFIELD, CALIF.

"TIME WILL TELL"

THE GEOLOGRAPH CO. INC.

P. O. Box 1291 Oklahoma City 1, Okla.

NO SCORING OF BRAKE DRUMS!



. . . another reason why drillers prefer

Standco NO-SMOKE BRAKE LINING

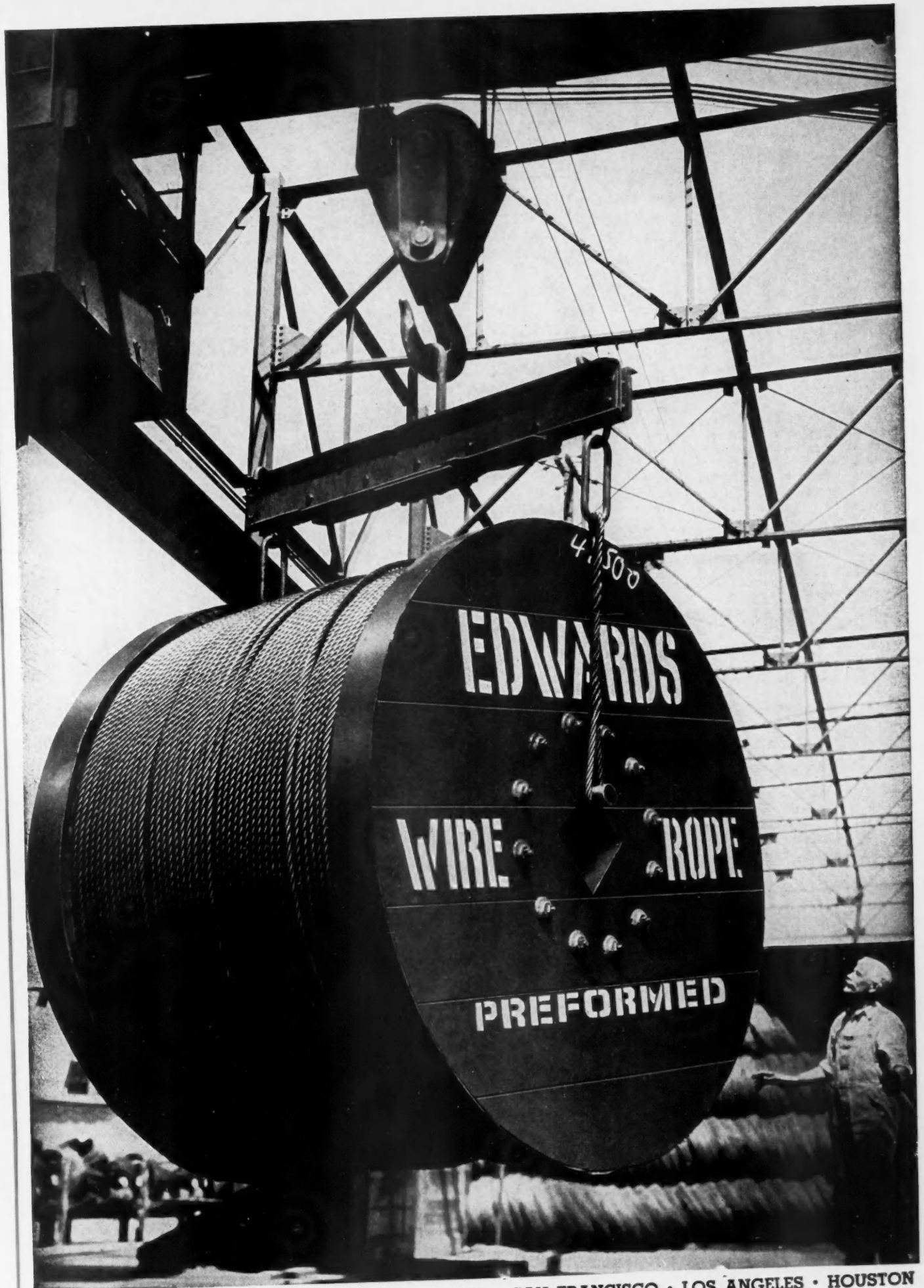
Standco Brake Blocks are made of cabled cords of long fibre asbestos — woven solid and reinforced with bronze wire to prevent pulling loose on the bolts. They will not burn or smoke or score brake rims.

More deep wells have been drilled with Standco than with all other blocks combined. It's your answer for low-cost hole-making.

STANDCO BRAKE LINING COMPANY

Factory and General Offices

2701-2801 Clinton Drive Houston, Texas



E. H. EDWARDS COMPANY — SEATTLE • PORTLAND • SAN FRANCISCO • LOS ANGELES • HOUSTON

SAFER, FASTER JACKING
• ON RIG SKIDDING
• MACHINE MOVING
• IN CONSTRUCTION
with SIMPLEX Geared Jacks

Models 25 to 35 Tons Cap.

Designed for heavy duty action, engineered to save time and money on scores of jobs. 25 ton models shown have right and left hand toe lifts, respectively, for paired operation. All furnished with oval hickory lever poles for maximum strength.

SEND FOR BULLETIN: OIL 49

Simplex
LEVER • SCREW • HYDRAULIC
Jacks
TEMPLETON, KENLY & COMPANY
1032 So. Central Ave., Chicago 44, Illinois

KERN
DIRECTIONAL DRILLING CORP.
• SIDETRACKING
• STRAIGHTENING
• CONTROL DRILLING
• CONSULTING
HOUSTON: P. O. Box 8055
Phone: KEystone 6123
ABILENE: G & L Tool Company
Phone: 5555
CORPUS CHRISTI
Specialties Warehouse
Phone: 3-4488

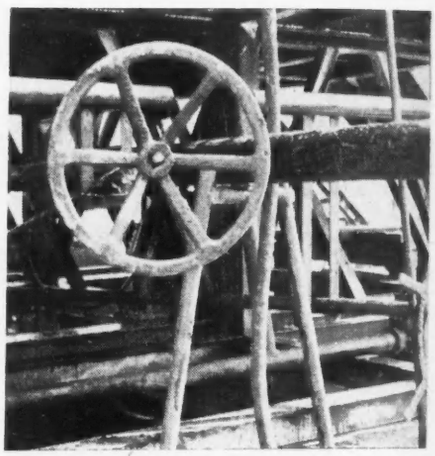
PRINTED FORMS FROM STOCK
Immediate delivery of producing and pipe line forms made from our complete line . . . Write for completely illustrated catalog.
GULF PUBLISHING CO.
P. O. BOX 2608 HOUSTON 1, TEXAS

reversed out. However, when it comes to starting the threads on the new plug into the head, the mechanic must use his hands. In doing so, he stands a good chance of being burned by the hot engine.

This clever device is simply a short piece of old welding hose about ten inches long. The nut on the new spark plug is tightened up and the hose fitted over the top end of the spark plug and nut so that the plug can be held by the hose. The mechanic may then guide the plug into the recess in the engine head and engage the threads. He has ample space in which to observe the position of the plug and therefore requires little time to get the plug started. Once the threads are engaged, a wrench can be used to finish the job.

HOW TO—Brace Extension Handles

A method of eliminating the two-legged or tripod stands commonly used to support the outer end of the blowout preventer extension handles is employed by one drilling company. The supports consist of narrow rectangular "slots" suspended from horizontal bars welded to convenient members of the substructure. Made of light angle iron welded in the manner shown, the supports easily can be made up and fitted to any rig, their length, size of opening and relative position being determined by the position and type of preventers used on the well. They are easily cut off and repositioned should a change in preventers or other equipment require such a shift of the supports.



Their use eliminates the need of the portable stands, leaves more ground space in the immediate vicinity of the derrick and reduces the number of pieces of equipment that have to be moved and set up at each location. With this type of installation the possibility of anyone's shifting or upsetting the tripod supports is eliminated.

HOW TO—Protect Clutch Controls

Engaging and disengaging the rotary and drawworks drum clutches on most rigs is still done by the use of foot pedals placed at floor level at the driller's position. While not delicate pieces of equipment, these pedals must be protected from damage to insure their proper function.

To prevent heavy objects moved about the derrick floor from smashing into these clutch pedals, a forward steel guard rail is installed as shown. It consists of a piece of one-inch round bar stock steel welded to the floor plates on the drawworks skid. The guard extends about ten inches off the floor and is about 20-inches long. It is heavy enough to provide adequate protection against tools and other pieces of equipment that might accidentally be thrown against the clutch pedals.

To the top of the guard is welded an anchor or hold-down chain which secures the drawworks drum brake in position. The end link of the chain is tack-welded to the upper side of the bar steel guard.

Applications and Results of The Hydrafrac Process

By W. E. HASSEBROEK
Development Engineer, Mechanical Research Department,
Halliburton Oil Well Cementing Company, Duncan, Okla.

THE HYDRAFRAC process, developed by Stanolind Oil and Gas Company, with its varied forms of application has become recognized as a valuable method of increasing production from oil and gas wells. While at first intended as a means of recovering additional reserves and of increasing the production rate of older wells, the procedure is now well established as a new well completion method.

INCREASE in production is obtained by hydraulically fracturing the producing formation, thereby generating new and greater effective permeability within the zone being treated. This is accomplished by hydraulic pressure transmitted with high viscosity fluid pumped into the zone under treatment. This viscous medium, referred to as a gel, is of such high viscosity that entry into the formation under a given rate of flow can produce pressure in excess of that attributable to overburden, and thus create a splitting of the formation. This gel later is returned to approximately its original viscosity by following it down the well with oil containing certain chemicals which assist in causing the gel to break down.

The gelled mixture in this process carries suspended quantities of graded sand grains of approximately .026 inch diameter which are added during gel preparation. This selected sand acts as a propping agent to hold the produced fracture open. Thus, when the pressure is released and the fracture tends to close due to overburden load, it is held at least partially open by the sand particles distributed within the fracture.

At the conclusion of injection, the well is allowed to remain shut in under the final pump pressure for approximately 24 hours, after which it may be placed back on production without any cleaning out such as is necessary after shooting with nitroglycerin. Swabbing is recommended if the well does not flow. The breaker fluid, the gelled medium which has reverted to its original viscosity, and new oil may all be run to the tank battery without further treatment.

The gel is prepared by adding an oil-soluble soap to a petroleum fluid base such as kerosine, diesel fuel, crude oil or a mixture of these. Originally war surplus Napalm (aluminum stearate) was used because of its availability and performance. Later developments have led to the use of a much improved material which has properties considerably more suitable for hydraulic fracturing purposes. Recent studies indicate that breaker agents may be entrained in the gel during the process of preparation, thereby giving better assurance of viscosity breakdown. Since the fluids employed in this treatment in sands are basically hydrocarbons, water blocking is eliminated, an occurrence found frequently in certain sand formations where water-base fluids are used.

Formations containing oil but having permeabilities insufficient to produce it with existing bottom-hole pressures are likely candidates for successful Hydrafrac application. Analysis of production histories will often aid in selecting wells for treatment. Wells which have produced for a period of years with a very gradual fluid and bottom-hole pressure decline indicate a possible reservoir depletion. These usually are poor risks for treatment. Many wells, however, show a relatively rapid production drop during some period of their life, indicating abnormal permeability or pressure stoppage. A Hydrafrac treatment in such a case will often lead to restoration of productive capacity and may even result in a producing rate greater than originally existed.

Frequently a small well is completed in the midst of several good producers. Examination of electric logs and other formation data sometimes shows a smaller section of sand with poorer development than found in the better wells. Hydrafrac treatments in these types of zones have led to increased production, probably by producing and extending a fracture into a better developed section some distance from the bore hole.

A well in the Pennsylvania sand near New Hope, Okla., was completed flowing 29 barrels of oil per day in an area where other wells were flowing considerably more oil. An injection of large quantities of chemically treated crude failed to gain any increase. The well was then given a Hydrafrac treatment resulting in a flow of 200 bopd afterward, a value comparable to surrounding wells. One year later reports stated this well was still producing 106 bopd. Figure 1 shows the pressure curve recorded during the Hydrafrac job on this well. Note the small pressure drop during the course of fluid injection. This slow decline in pressure is typical of a large number of succesful treatments and is believed to be more representative of an existing fracture extension rather the creation of a new one.

Several other well conditions must

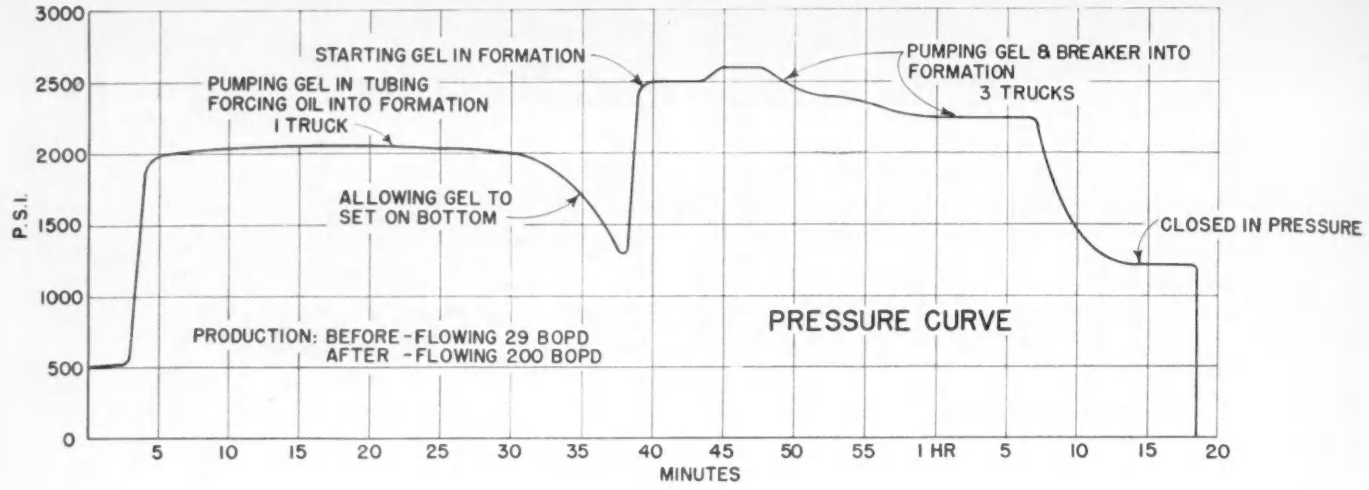


FIGURE 1. Well F, Pennsylvania sand, New Hope field, Oklahoma.

be reasonably satisfactory in order to obtain production increases. Experience has shown zone isolation to be one of the most important factors for successful Hydrafrac treatment. Normally only one fracture can be expected during the course of a single injection which, if occurring in a nonproductive section, will likely result in failure. In Figure 2 is shown the pressure curve during a treatment on a well producing from open hole near Wichita Falls, Texas. Although a sharp pressure break indicated a fracture was formed, it apparently entered a nonproductive section since no increase in production was obtained, the well remained at 12 bopd the same as before treatment. This type of pressure drop, quite in contrast to that found in Figure 1, has been observed on a number of unsuccessful treatments, particularly in the Mid-Continent region. By cementing the casing shoe well within a sand body and also plugging back excessive hole with plastics and cements, much can be done to aid zone isolation and prevent fracturing at undesired levels.

Where casing is set through and perforated, formation segregation is dependent to a large extent on quality of the cementing job behind the pipe. It has not been uncommon to receive communication between closely spaced zones during the course of a Hydrafrac treatment. This has led to greater concentration on efficiency of casing cementing. Better mud control, an increase in the use of mechanical wall cleaning devices and casing centralizers and mixing of larger quantities of proper cements have had a noticeable effect on successful completion of Hydrafrac jobs.

Much has been accomplished by careful selection of intervals for perforation. Hydrafrac treatments in formations composed of alternate thin sections of sands and shales have often resulted in failure where the entire zone is perforated without regard to relative positions of the different strata; but outstanding results have been obtained by carefully perforating only the sand bodies.

Figure 3 shows a section of an electric log from a well in the Norris Sand, Carter County, Oklahoma, characteristics of which made forecasts of commercial production questionable. This well was perforated with 16 shots at 3502-06 feet and again with 16 shots at 3514-18. A swabbing test showed an initial production rate of four bopd. A Hydrafrac treatment was then performed which resulted in the well flowing 70 barrels per day afterward. One month later it was still flowing an average of 60 bopd. A number of wells in this locality have responded similarly, resulting in a very profitable return to well owners.

Large Bodies of Sand

Where larger bodies of sand are present, the well owner will often perforate the entire section and even overlap into the adjoining zone above and below, which is usually a shale. This exposes the bedding plane between the two which, being a point of weakness, will usually take the Hydrafrac fluids, thus preventing fracturing of the sand itself. This procedure should be avoided. General practice in many areas now is to perforate the central portion of the sand with the upper and lower holes placed three to five feet from the nearest shale contact. After treatment and test, the remainder of the zone may be perforated if desired. Quite often, production increase is such that additional perforations are not believed necessary, especially in wells which respond by flowing.

Although the process has been applied by single injection with some success to exposed sections 100 feet or more in length, odds are against receiving satisfactory results when doing so. Too much opened section may have sufficient permeability so that fracturing pressures cannot be reached, the gel being merely pumped into the void space between sand grains. Rarely are sections greater than 50 feet thick recommended for a single treatment. Majority of treatments are for intervals ranging from 10 to 30 feet long. It is usually better to divide long sections and treat smaller portions at a time.

Special tools with dual packers have been developed for open-hole use and have proved very satisfactory in hard formations, such as found in West Texas and the Rocky Mountain regions. As many as 10 different intervals have been fractured in one hole at Rangely, Colorado. Adaptations of this tool and other standard packers have permitted multiple fractures through perforations in other localities, particularly in the Springer sand formation of Oklahoma and the Travis Peak in East Texas and North Louisiana.

During the development stage of the Hydrafrac process it was found that gel volumes of 18 to 20 barrels per treatment gave optimum economical results. During later commercial application, observations have indicated better results are accomplished under certain conditions by increasing this volume. In wells with considerable sections of zone exposed, in open holes that have been shot, and in wells located on the edge of a

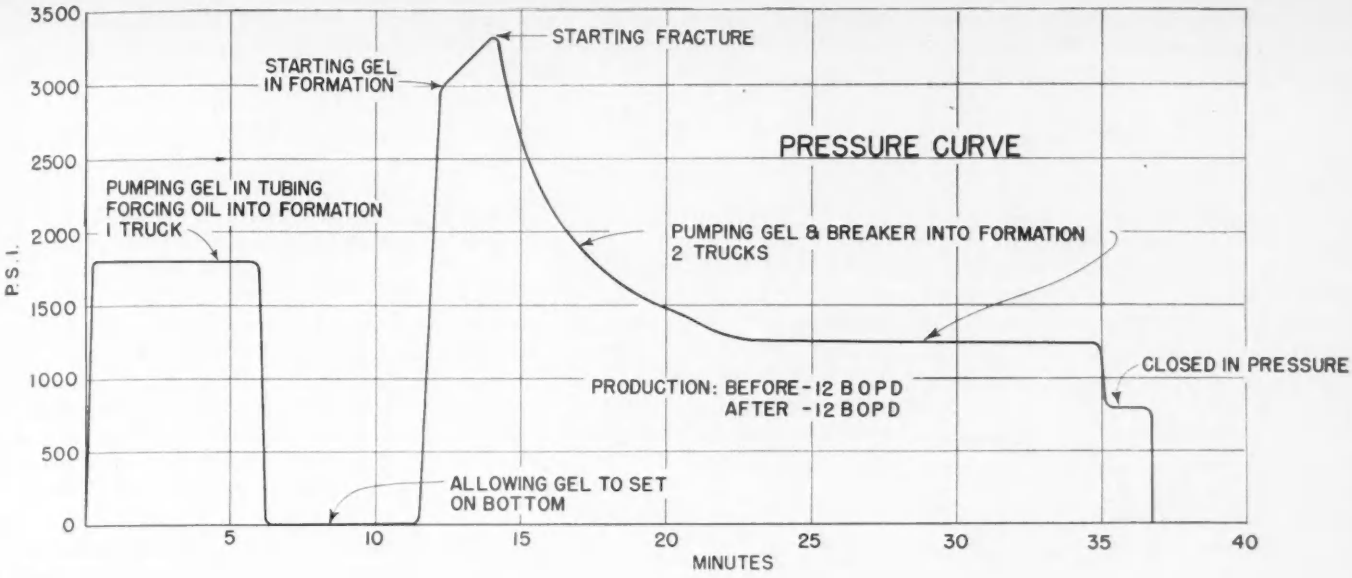


FIGURE 2. Well E, Strawn sand, Wichita Falls, Texas.

structure, volumes of 35 to 40 barrels of the gelled medium have been used with marked success. The number of these larger volume treatments is increasing, particularly in the Oklahoma and West Texas areas. Comparison of results in localities of interest will usually show whether or not the additional expenditure is economically practical.

A survey of operations for one 12-month interval included a study of accurate results on all wells treated. Three of every four wells to which the process was applied resulted in what could be termed a commercial increase in production. It has been impossible to obtain authentic information on each of the many jobs performed since then, but a check of results available indicates this percentage still remains true.

In Table 1 are listed the number of Hydrafrac treatments by areas in the U. S. over a period of 21 months. As noted, the majority of jobs have been in Oklahoma. Formations in this area are firm, relatively low in permeability and have considerable body thickness. The 77 formations listed extend into 36 counties, representing practically every producing section of the state.

The leading formation to date has been the Red Fork sand with 194 treatments. This is a relatively shallow sand between 2000 and 3000 feet found primarily in the north central and northeastern sections of the state. A large number of wells in this formation will have nothing more than a show of oil when drilled. After Hydrafrac treatment, many will flow for a short time as much as 300 barrels per day. Production decline usually is relatively rapid with settled production in three to six months of 8 to 60 barrels per day. These wells, shallow in depth, result in a large flush production after initial completion and settling to a small steady producing rate with long life expectancy, and appeal to many operators from an investment viewpoint.

Although space does not permit listing each formation treated, other important ones have been the Bartlesville, Gibson, Deese, Springer, Prue, Cisco, Cromwell, Layton, Calvin and Gilcrease sands. One recent Prue well, making only a show of oil originally, was reported to have flowed 535 barrels per day on test after recovering all fluid used in the process application. Another, testing 20 bopd initially, flowed 735 bopd after treatment. Increases are usually well sustained with production decline much slower than in the Red Fork.

Outstanding success has been obtained in deeper formations, such as the Gibson and Deese sands of south central Oklahoma in the Golden Trend Area. Production increases are well sustained as indicated in Figure 4 in which production before and after Hydrafrac treatment of a well producing from the Hart zone of the Deese sand is shown graphically. This well had produced for 11 months at the rate of from 50 to 60 bopd, flowing by heads through an open choke with 60 pounds per square inch tubing pressure as indicated by the lower dashed line. Production for 11 months after treatment is represented by the solid curve. For two months the well increased in rate through a one-half inch choke producing at that time 110 bopd with 400 psi tubing pressure. Chokes were then changed, decreasing the flow to meet allowable schedules. At the end of the 11-month period an official state test showed the well capable of flowing 104 bopd.

In Tillman County, southwestern Oklahoma, a large number of wells were completed within the last year in the Cisco sand approximately 2700 feet in depth. One operator, who drilled about 35 wells in this area, used the Hydrafrac process as a completion procedure on every well. Original production of most of them was only a show of oil with a few of the better ones making 10 to 20 barrels per day. Results after Hydrafrac treatment were said to be an average of 150 bopd flowing initially after recovering load oil, declining to a rate of 75 bopd pumping two months afterward with a per well average of 25 barrels per day five months later. Hydrafrac treatment increased every well treated resulting in 100 percent success for the well owner.

Most sands of North and Central

Table 1
Hydrafrac Treatments by Areas

No.	AREA	Number Treatments	Number Formations
1	Oklahoma	1,282	77
2	North Texas	297	18
3	Central Texas	256	27
4	Kansas	106	12
5	Rocky Mountains	67	10
6	West Texas	59	13
7	Eastern	53	9
8	California	32	9
9	East Texas	27	6
10	Southwest Texas	14	10
11	N. La.—Ark.—Miss.	12	8
12	Texas Panhandle	7	2
13	South Louisiana	7	2
14	South Texas	6	3
	Total	2,225	

Texas contain some lime and many of them shale streaks. The more successful sands usually contain a very small quantity of shale, are medium fine and well consolidated. There have, however, been some successful Hydrafrac treatments in the conglomerate and in porous shaly sands. One well in the conglomerate in Wichita County, originally testing five bopd, flowed 80 bopd after Hydrafrac treatment. At the end of nine months it was still flowing 48 bopd and 18 months after treatment is producing 14 bopd.

Many wells in this area producing from the Strawn series have been helped materially by Hydrafrac application. Permeabilities in the Strawn are relatively low, ranging from less than one to as much as 200 millidarcys. Bottom-hole pressure is fairly good with production in most areas resulting from a solution gas drive which has played a large part in success, but treatments on wells making small amounts of water have sometimes resulted in quite an increase in water content. Outstanding results have been obtained in the oolitic lime portion of the Strawn which heretofore has not responded to explosives or acid to a very large degree.

Activity has increased considerably throughout the general area of what is termed Central Texas, particularly in Fisher, Jones, Shackelford, Taylor, Stephens, Runnels, Coleman and Eastland counties. Reports show that 85 percent of wells treated in this area have resulted in successful production increases. Those treated through perforations have given better results than those in open holes. Recently a new well bottomed in the Mississippi lime near Breckenridge, Stephens County, Texas, which had no oil on initial test, was completed for 168 bopd flowing after Hydrafrac treatment. The Lake sand near Cisco in Eastland County, a relatively soft sand in which shooting has not been overly effective, has responded very well with 17 of 18 wells treated having been successful. Initial production in this formation ranges from 10 to 100 bopd with potentials after treatment showing 300 to 400 bopd. One well is reported to have flowed at the rate of 1200 bopd after treatment.

Use in Completion

Many operators are using the process as a completion means, even though natural production is more than sufficient to meet allowable schedules. It is more economical and convenient to perform the work while the drilling rig is over the hole. Too, by increasing the effective permeability while the well is new, the decline rate is believed to be lowered, thus postponing the time at which additional work or well stimulation is required. A well in Fisher County, Texas, made 70 bopd natural. Immediately after Hydrafrac treatment, it tested 240 bopd. One year later this well was still flowing 140 bopd which, according to reports, is considerably better than others in the same area completed by other methods.

Only recently has the Hydrafrac process been used to any extent in West Texas. Primarily a limestone region, the use of acid has been very effective and profitable. The discovery of Spraberry sand production in Midland County, however, has opened an area of application for the process. Eighty percent of the wells treated in this formation have been highly successful. All have been new wells with a reported initial production averaging one barrel of oil per hour. After Hydrafrac treatment average flow has been 10 to 15 barrels per hour. Good results have also been obtained in selected wells producing from the Yates sand in Ward and Pecos counties, the Queen sand in Crockett and Pecos counties and from the Delaware in Loving County. Results are not entirely consistent but are sufficient to indicate considerable future work in these formations, providing wells are completed in a manner to allow proper application.

Although formations in Kansas are also mostly lime in which acid has done so much to increase the flow of oil, there are a number of sands that are not responsive to acid treatment. It is in these formations that the Hydrafrac process to date has been most applicable. A number of successful treatments have been performed in the Reagan and Gorham sands in Barton County and in the Tarkio sand in Russell County. In the eastern part of the state the Bartlesville, Wayside and Weiser formations have responded with profitable increases. Larger volume treatments are proving effective in certain sections of the state. From results obtained during the latter half of 1950, much may be expected in the future from use of the process in this region.

Formations in the eastern area, i.e., Illinois, Kentucky and Indiana, are relatively shallow and generally have a low bottom-hole pressure. The first few Hydrafrac treatments were not classed as commercially successful. Older wells which had been shot with nitroglycerin failed to respond. Methods of completion made zone isolation most difficult. However, consistent well analysis coupled with variations in treatment technique have led to a profitable degree of success in later wells treated. Of 42 wells in which the Hydrafrac process has been applied recently, 22 were through perforations with approximately 75 percent of them commercially successful. Twenty were in open hole of which 45 percent were successful. By carefully perforating selected intervals, zone isolation can and has been accomplished in this area. Successful open hole treatments have

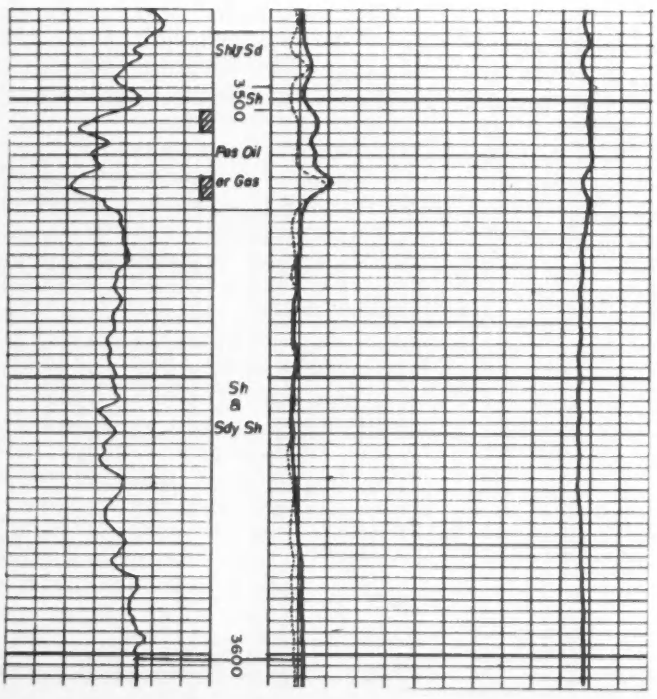
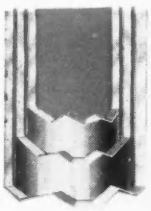


FIGURE 3

26 years of Specialization

has enabled Fluid Packed Pump Company* to be . . .

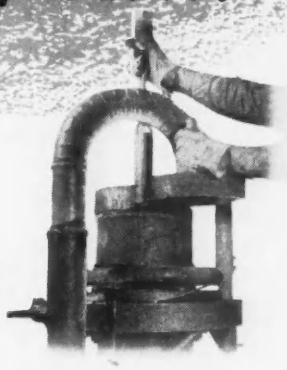


First

. . . with the Multiple Tube Fluid Packed Pump—The oil country stand-by for dirty wells.

First

. . . with a process to economically produce *one-piece uniformly hardened pump barrels* in unlimited quantities.

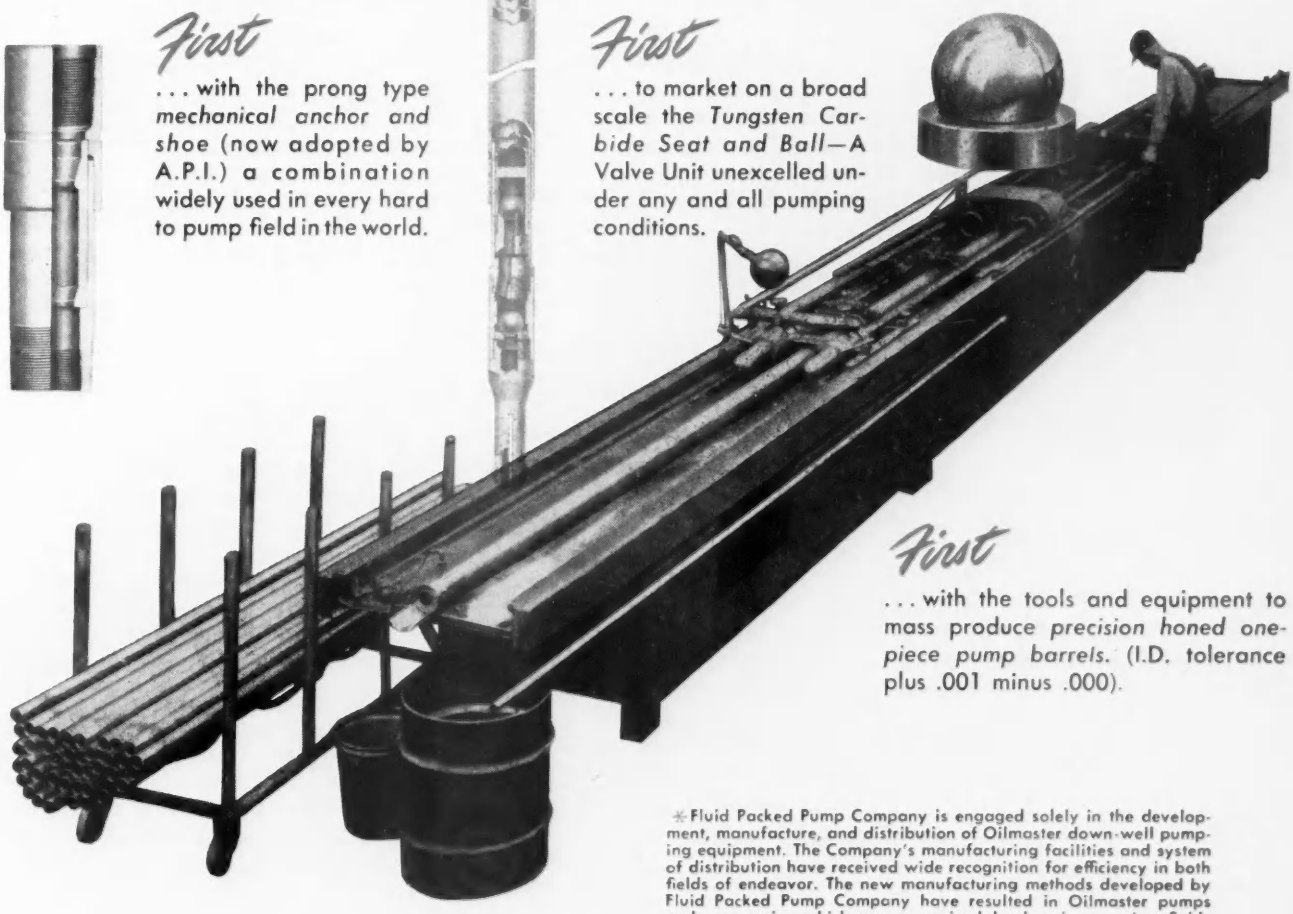


First

. . . with the prong type *mechanical anchor and shoe* (now adopted by A.P.I.) a combination widely used in every hard to pump field in the world.

First

. . . to market on a broad scale the *Tungsten Carbide Seat and Ball*—A Valve Unit unexcelled under any and all pumping conditions.



First

. . . with the tools and equipment to mass produce *precision honed one-piece pump barrels.* (I.D. tolerance plus .001 minus .000).

*Fluid Packed Pump Company is engaged solely in the development, manufacture, and distribution of Oilmaster down-well pumping equipment. The Company's manufacturing facilities and system of distribution have received wide recognition for efficiency in both fields of endeavor. The new manufacturing methods developed by Fluid Packed Pump Company have resulted in Oilmaster pumps and accessories which are recognized leaders in pumping fields all over the world.

OILMASTER PRODUCTS

FLUID PACKED PUMP COMPANY • LOS NIETOS, CALIFORNIA

DISTRIBUTED BY THE NATIONAL SUPPLY CO.

EXPORT: THE NATIONAL SUPPLY EXPORT CORP., 30 ROCKEFELLER PLAZA, NEW YORK

CO-DISTRIBUTORS: BERRY SUPPLY STORE, BEACON SUPPLY CO., INDUSTRIAL SUPPLY CO

been on sand sections of 12 feet or less in thickness. In old wells which have been shot and in completing new wells which show for poor production, an increase in volume of gel and other chemicals has proved advantageous.

The Rocky Mountain region, containing very dense sand formations, has responded well to fracturing treatments. Successful Hydrafrac applications have been performed in the Muddy, Frontier and Tensleep sands of Wyoming and the Weber of Colorado. Vertical fractures occurring naturally within exposed sections have caused some difficulty in zone isolation, but the use of special open hole packers has done much in permitting multi-treatment application. Due to extremely low permeabilities, treatments using crude as a fracturing medium have also given excellent results, this being one of the few regions where lower viscosity fluids have proved economically feasible.

Long producing sections through perforated or slotted liners in California have limited the use of Hydrafrac treatments in that region. One particular field in Kern County has responded exceptionally well to the process where casing is set through and gun perforated in selected portions of an oil-producing shale. Reports on six wells treated show that five have resulted in good production increases. One well, which failed to flow at completion, is reported to have flowed 227 to 339 bopd through different size chokes during a 30-day test after treatment. Another, making 49 barrels originally, tested 531 barrels flowing through a 42/64-inch choke afterwards. A third well with initial test of 133 bopd through a 12/64-inch choke is said to have flowed 1200 bopd through a 38/64-inch restriction and 323 barrels through a 12/64-inch choke during a one-month observation after treatment. By completing wells in this area with the purpose of Hydrafrac application in mind, profitable results are being obtained.

In general, formations of East Texas, Arkansas, Louisiana and the lower Gulf Coast region are highly permeable, which limits the need of a process of this nature. A few successful treatments have been obtained in isolated parts of this area but not to the extent found in regions further north. Of interest is one well completed in the Woodbine sand of East Texas making no oil before treatment which tested 62 bopd afterwards. Reports state that now, nearly three years later, this well is still capable of producing 60 bopd, although prorated to a 20 barrel per day allowable.

A variation in the Hydrafrac process technique has been used in South Louisiana as an aid in controlling the flow of sand from unconsolidated formations. Here the gelled medium serves as a means of transporting, from the surface to the producing zone, large quantities of selected sand to accomplish a sand packing operation. Following placement of this special material and after the gel viscosity has been broken, a sand consolidation job is performed with resinous fluids to hold the particles in place. This procedure has been referred to as a Hydrafrac-sand pack job. One particular well had not been produced for some time because of inability to cope with the large quantities of formation sand entering the hole. It was treated in the above-described manner and although now making a large amount of water, it is reported producing 25-30 bopd with no sand. Not all formations are amenable to this treatment method and careful well analysis is necessary to determine the practicability of the consolidating procedure.

A simple technique has recently been perfected whereby a combination Hydrafrac and acid treatment may be satisfactorily performed. The introduction of this service opens a vast new field for fracturing of tight limestone which may prove of immense value in additional oil recovery from certain types of formations. In this procedure the Hydrafrac gel, containing certain additional chemicals, is pumped into the well and followed immediately with a predetermined quantity of hydrochloric

■ CONTINUED ON PAGE 148

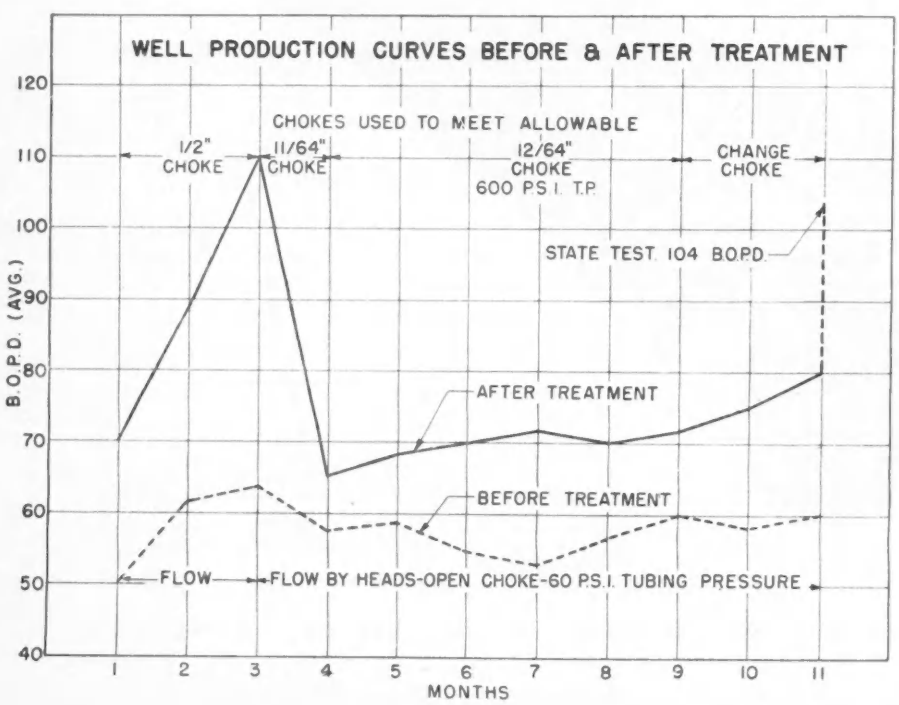
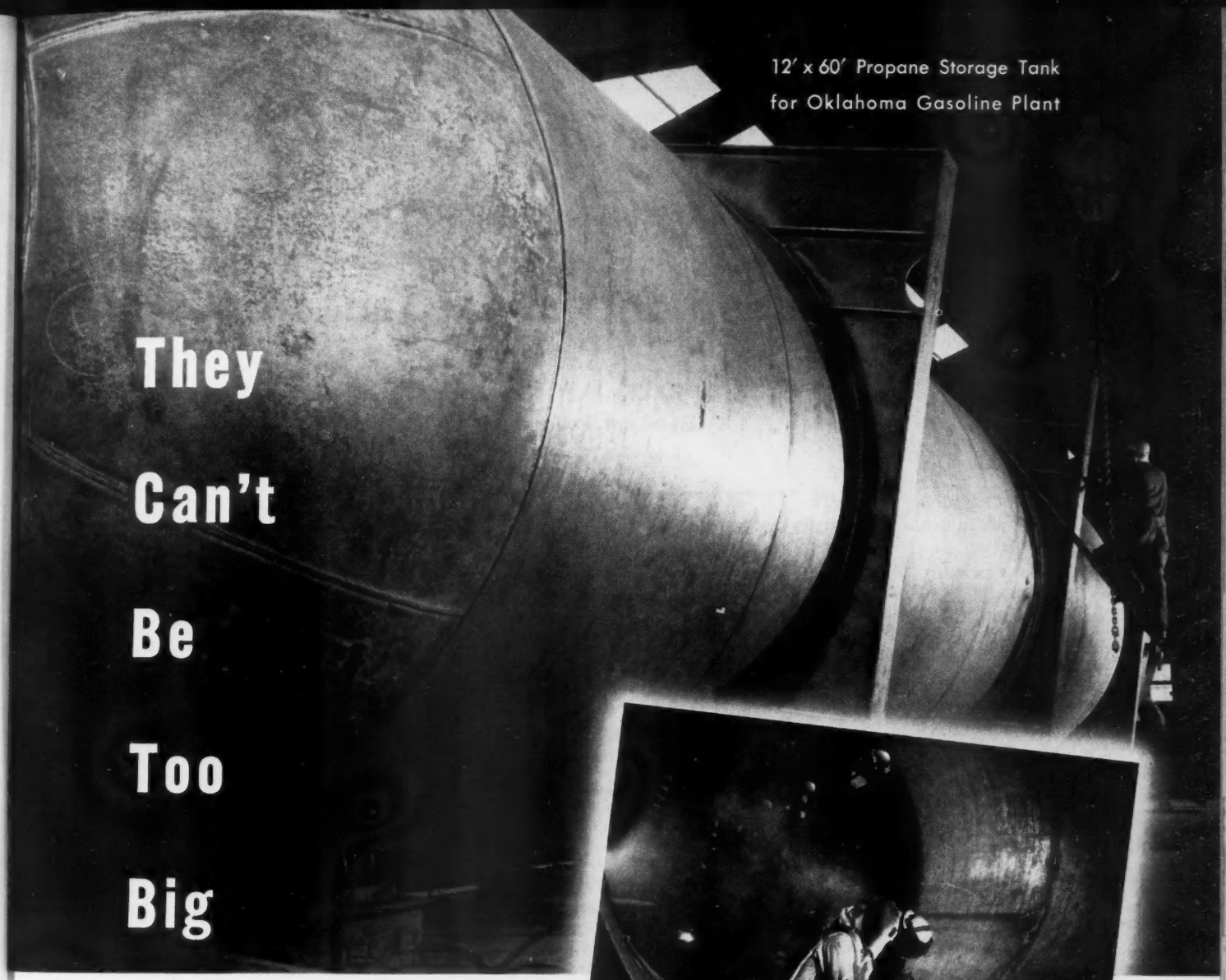


FIGURE 4

About the Author

WILLARD E. HASSEBROEK attended Oklahoma A. and M. College, graduating with degree in chemical engineering in 1935. Upon graduation, he joined Halliburton Oil Well Cementing Company and during the next seven years served in the operational and engineering departments of the company's Kansas, Oklahoma, West Texas and North Louisiana divisions. In 1942 he returned to the home office at Duncan, Okla., where he is now development engineer in the Mechanical Research and Development section of the Engineering department of Halliburton.



12' x 60' Propane Storage Tank
for Oklahoma Gasoline Plant

They Can't Be Too Big For National . . .

Serving the oil industry all over the world, the large and up-to-the-minute facilities of the National Tank Company assure its customers the best in design, workmanship and materials. Years of experience in producing oil field equipment, a highly-trained staff of engineers and employees and 33 field warehouses and service branches were recently supplemented by a large plant expansion. Two 50-ton cranes, six 10-ton cranes, seven 5-ton cranes, a 400-ton hydraulic press and a huge annealing furnace (15 by 15 by 100 feet) are only some of the new facilities for processing and producing the latest scientific equipment for National's customers.

The best is yours when "It's a National."

It's a National

NATIONAL TANK COMPANY

TULSA, OKLAHOMA

Electric Log Resistivity, Porosity and Water Saturation For Clean and Shaly Sandstones

By PARK J. JONES
Consultant, Houston

THE AUTHOR points out the possibility of erroneous and probably low evaluation of shaly sandstone intervals from electric log data unless interpretation is based on consideration of shale content. He presents a procedure which may serve as primary standard for calibration of resistivity logging devices, both in field and laboratory.

ELECTRIC log data are generally used in estimating the porosity and water saturation of clean (nonshaly) sandstones with the aid of Archie's equations,[1,2,3] but in the case of shaly sandstone the cementation factor may not be known, and the in-place oil and/or gas of the reservoir usually will be more than is indicated from electric log data not corrected for shale content.

Archie's equations for these determinations are

$$\frac{R_o}{r_w} = F = f^{-m} \qquad (1)$$

and

$$\frac{R_t}{r_w} = \frac{F}{S^2} \qquad (2)$$

in which the cementation factor m may be an unknown, when the reservoir is known to be a shaly sandstone. On the other hand, the writer's studies indicate that the formation factor F can be expressed as

$$F = 10^{(A-f)/B} \qquad (3)$$

where A and B are constants to be evaluated empirically for clean and shaly beds. The constants tentatively proposed on the basis of limited data are 46 and 19. Accordingly, the proposed formation factor for clean sandstones is

$$F = 10^{(46-f)/19}$$

$$\frac{R_o}{r_w} = 10^{(46-f)/19} \qquad (4)$$

and

$$\frac{R_t}{r_w} = \frac{10^{(46-f)/19}}{S^2} \qquad (5)$$

Archie's equation (1) is compared with the proposed equation (4) in Figure 1. The lines in Figure 2 are solutions of equation (5) for 10 to 100 percent water saturation. The data are limited to a porosity range of 8 to 36 percent and no change in bulk volume upon decreasing pressure.

The resistivity R_s of shale beds commonly ranges from less than one ohm-meter to more than 30. However, some oil-producing provinces have shale beds the resistivity for which ranges from 30 to more than 100 ohm-meters. It follows that the true resistivity R_t of a clean pay interval (oil or gas) may be less than, equal to, or greater than the resistivity R_s of the shale beds above and/or below the pay interval. However, it should be emphasized that bedded shale is not the only type of shale in sandstones. Students of petroleum development recognize three different classes of shale which are considered below.

In an oil or gas pay interval which contains beds of shale thick enough to be evaluated on an electric log, they are deducted from the interval thickness. But some intervals are the sum of alternate shale and clean sandstone beds too thin to be evaluated individually on an electric log. However, the presence of shale is indicated on an electric log, and it is assumed here that the shale content of an interval is known. Let Z be the fraction of an interval bulk volume which is shale beds and $(1 - Z)$ the fraction which is clean sandstone beds. Let R_s be the resistivity of the shale beds and R_t that of clean sandstone pay. The proportion of shale to sandstone beds across the interval gives an average resistivity R_z which can be found as follows: The conductivity $1/R_z$ is given by

$$\frac{1}{R_z} = \frac{Z}{R_s} + \frac{1-Z}{R_t}$$

from which

$$R_z = \frac{R_s R_t}{ZR_t + (1-Z)R_s} \qquad (6)$$

Figure 3 shows solutions of equation (6) for 5, 10, 20 and 40 percent shale beds in an interval. The average interval resistivity divided by shale resistivity is plotted against the ratio of clean sandstone resistivity to that of the shale beds. When the resistivity of clean sandstone beds is materially higher than that for shale, even a small proportion of shale beds greatly reduces the resistivity of the interval. But when the resistivity of the clean beds is materially lower than that of the associated shale beds, the resistivity of the interval is higher than that of the clean beds. The straight line in Figure 3 is for no shale beds in a clean sandstone interval. In the case of a water interval, substitute R_o/R_s for R_t/R_s provided there is no residual oil in the R_o interval below a water contact. When several electric logs are available, all data should be consistent as to pay thickness, shale content, porosity and water saturation.

Classification of Shales

Students of development and production of oil and gas reservoirs recognize three different classes of shale from the viewpoint of pay thickness, porosity, water saturation and permeability.

- Shale as a cementing material, silty or muddy material as in graywacke sandstones. This class of shale is accounted for on an electric log with the aid of the formation factor. Second,
- Shale beds under the pressure of the overburden.
- Silts and clays (shale) scattered in the voids of sandstones. This class of shales does not take the pressure imposed by the overburden. For example, the clay in bentonitic sand-

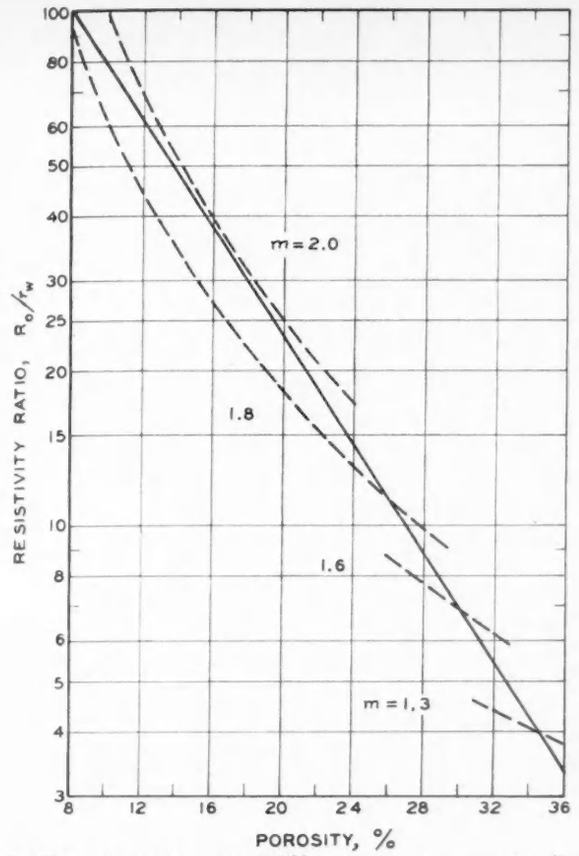


FIGURE 1. Resistivity ratio at 100 percent water saturation R_o to that of water r_w vs the porosity of media; m is Archie's cementation factor.

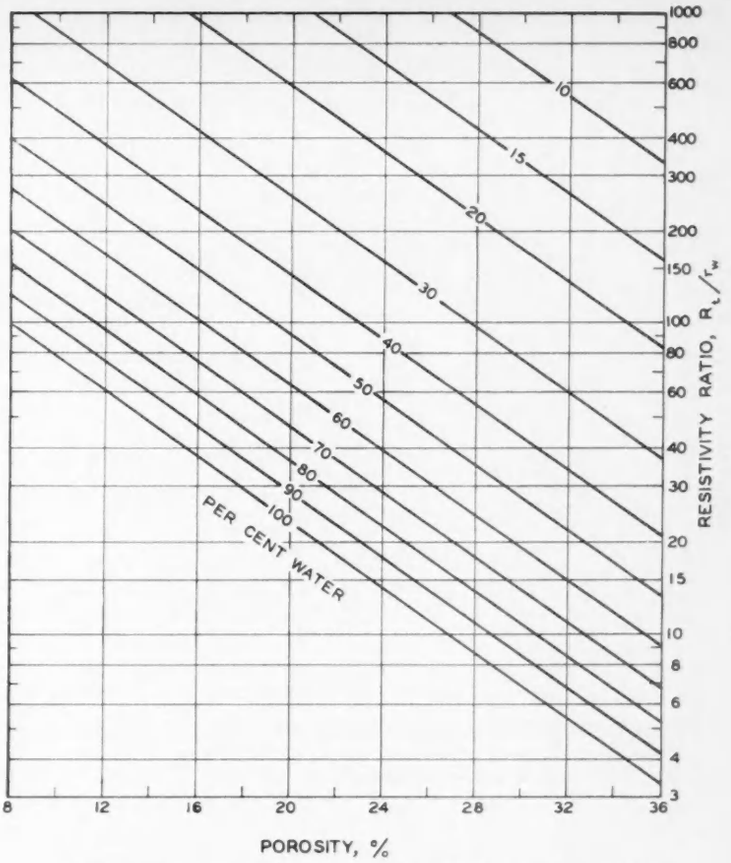


FIGURE 2. Resistivity ratio R_t/r_w of clean sandstones vs. porosity and water saturation.

stones swells in shallow or deep wells when wetted by fresh water. The BS found in crude oil often contains shale belonging to the third class. Figure 4 is a sketch of shale in sandstone. The shale reduces porosity to water and hydrocarbons, it is conductive if in salt water, but it would not be conductive if it could be insulated by oil or gas. This shale is moved by water. For these reasons, the shale of the third class is here considered to behave like a conductive fluid when in water. In most cases of commercial permeability nearly all the fluid shale is in water. This point is based on the productivity of oil and gas wells producing from shaly sandstone beds (see below).

Some work has been done[4,11] on shales; but much more remains to be done. Numerous symbols are required in order to show the effect of fluid shales on electric log resistivity curves. It therefore becomes necessary to standardize the symbols so that a reader will know at a glance whether beds or the fluids therein are under consideration—and also whether the beds are above or below a water contact, or whether an invaded zone in the immediate vicinity of a well bore either above or below a water contact is being investigated. The symbols herein follow in general those used in the Schlumberger publications.[12] However, a lower case r is used to denote fluid resistivities rather than an upper case R. The latter is reserved exclusively for bed resistivities. Clarity as to bulk volume of beds, total space and porosity occupied by water and hydrocarbons is also essential when the shale content of an interval is under consideration.

Resistivity of Shaly Water Beds

Consider a shaly water interval for which all the shale is in the pore space of the interval. The entire interval is sandstone having a total space f_t. The space f_t is occupied by shale and water. Let Z be the fraction of an interval which is shale and $(1-Z)$ the fraction which is clean sandstone. The bulk volume of the shale plus that of the clean sandstone in this particular example is equal to the bulk volume of the clean sandstone because the shale is between the grains of the sandstone. Accordingly,

$$Z = f_t - f$$

where f is porosity, that is, the fraction of bulk volume occupied by water.

The fraction $Z/(f+Z)$ is shale and $f/(f+Z)$ is water. Let r_s be the resistivity of the shale and r_w that of water. In order to find r_z, the resistivity of some proportion of fluid shale and water, write

$$\frac{1}{r_z} = \frac{Z}{(f+Z)r_s} + \frac{f}{(f+Z)r_w} \qquad (7)$$

from which

$$r_z = \frac{(f+Z)r_s r_w}{Zr_w + fr_s} \qquad (8)$$

The formation factor F_t relative to the total space $(f+Z)$ may be written

$$Ft = 10^{(46-f-Z)/19} \qquad (9)$$

Then the resistivity R_{os} of water beds containing Z percent of shale is assumed to be defined by

$$R_{os} = r_z \cdot F_t = \frac{(f+Z)r_s r_w}{Zr_w + fr_s}\, 10^{(46-f-Z)/19} \qquad (10)$$

When $r_s = r_w$, equation (10) reduces to equation (4). But when r_s is greater than r_w, it is necessary to apply the average resistivity r_z. It also remains to be confirmed by appropriate experiments whether the constants in the proposed formation factor for total space are on the order of 46 and 19.

Figure 5 shows some solutions of equation (10). Resistivity ratio R_{os}/r_w is plotted against porosity for zero, 5, 10 and 15 percent shale content. The solid lines are for shale resistivity equal to that of in-place water. The dashed curves are for shale resistivity

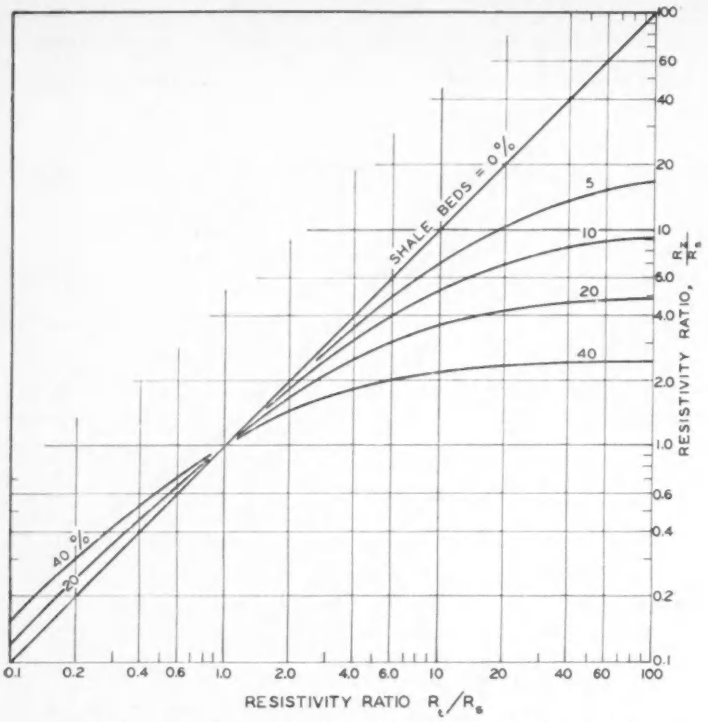


FIGURE 3. Resistivity of alternate thin beds of shale and clean sandstone vs. the resistivity ratio of clean sandstone to shale beds for 5, 10, 20 and 40 percent shale beds per interval.

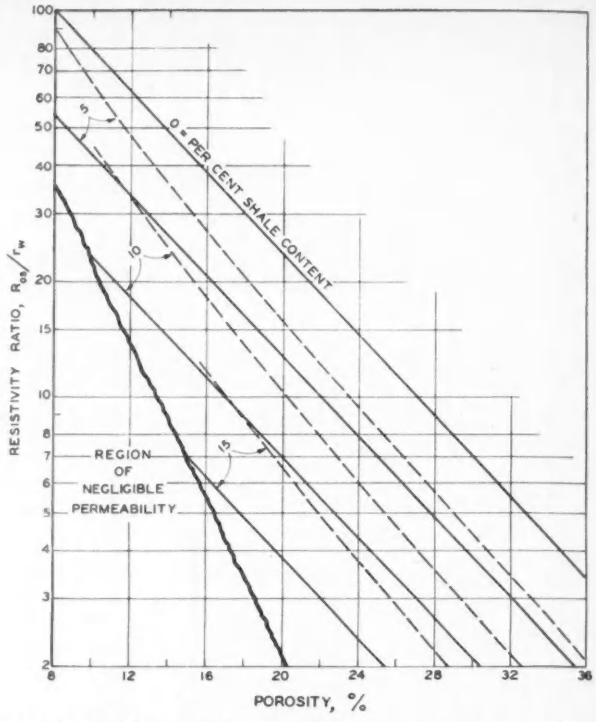


FIGURE 5. Restivity ratio R_{os}/r_w at 100 percent water saturation vs. porosity at zero to 15 percent shale content; r_s/r_w equals unity for solid lines and greater than 10 for dashed curves; the region to the left of the wavy line is likely to be commercially impermeable.

more than ten times that of in-place water. Permeability is likely to be negligible in the region to the left of the wavy line. The true resistivity ratio R_{os}/r_w for the long normal and/or lateral curves is not likely to be less than three. But the short normal resistivity ratio (not considered here) for a completely invaded region could be less than three when the shale resistivity is less than that of a filtrate.

Distribution of Fluid Shale

The distribution of fluid shale in the case of 100 percent water saturation may have no effect on the resistivity of a shaly sandstone. But in the case of oil or gas pay, the distribution of shale would be of interest if some of the shale were insulated by hydrocarbons. The probable distribution of shale ranges from zero to unity per unit of that portion of total space which contains some shale. The considerations in Table 1 are intended to illustrate the importance of fluid shale distribution in sandstone oil or gas pay.

Lines (1), (2) and (3) are in percent of bulk volume. Water saturation S is in percent of porosity. Lines (5) through (8) are in percent of total space. The last three lines are illustrated in Figure 6. The diagrams are drawn on the assumption that shale distribution ranges linearly from zero to unity in that portion of total space which contains some fluid shale. The permeability of diagram (c) is likely to be too low for commercial production. Comparison of permeability with diagrams like those in Figure 6 indicates that the fluid shale insulated by hydrocarbons is practically negligible.

The permeability to fresh water of sandstones containing hydratable fluid shales may be 1/10 to 1/100 of the permeability to air for the same sandstone. The comparatively high air permeability indicates that the distribution of fluid shale in that portion of total space occupied by the shale may be exponential rather than linear. That is, a shaly sandstone pay may be commercially permeable for a higher shale content when the distribution of the shale content is exponential rather than linear as shown in Figure 6. An experimental proce-

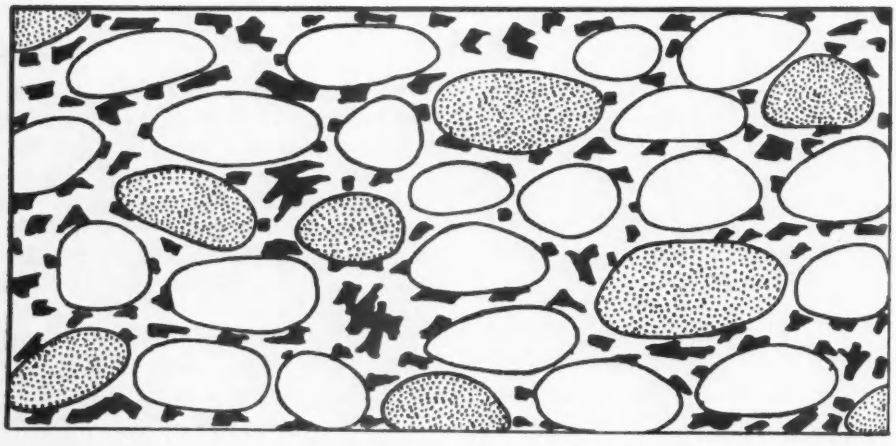


FIGURE 4. Sketch to illustrate fluid shale (silt and/or clay) which is conductive in water, nonconductive if in oil or gas, and reduces porosity to hydrocarbons and water; the larger shapes represent highly magnified sand grains.

TABLE 1

Line						
(1)	Total space, f_t	36	30	24	18	12
(2)	Shale, Z	6	6	6	6	6
(3)	Porosity, f	30	24	18	12	6
(4)	Water, S	20	30	40	50	60
(5)	$100\ f/f_t$	83.3	80.0	75.0	66.7	50.0
(6)	$100\ Z/f_t$	16.7	20.0	25.0	33.3	50.0
(7)	fS/f_t	16.7	24.0	30.0	33.4	30.0
(8)	Oil or gas	66.6	56.0	45.0	33.3	20.0

ompare These Features...

Take a glance at the left-hand page! You are looking at the last word in well head, high-recovery, Low Temperature Separation. This equipment will increase your recovery in the stock-tank of stable condensate as much as 8 or more barrels per million CF of gas produced over conventional separation. Yes, it's another dependable, field-proven, money-saving BS&B product.

MAKE YOUR OWN COMPARISON:

- INCREASED SEPARATOR LIQUID DEPTH insures maximum stabilization for greater stock-tank recovery.
- INCREASED SEPARATOR LIQUID DEPTH reduces chance for hydrate accumulation.
- DEPENDABLE BS&B CONTROLS for trouble-free operations.
- CONCENTRIC TUBE-IN-TUBE HEAT EXCHANGER for high efficiency.
- HIGH VELOCITY CENTRIFUGAL SEPARATION gives high separation efficiency.
- BS&B TEMPERATURE CONTROL assures maximum water removal in water knock-out and constant separator temperature.
- TAILORED TO ANY OPERATING CONDITION to insure maximum operating efficiency.
- PAYS FOR ITSELF IN A SHORT TIME!
- CALL YOUR BS&B FIELD MAN RIGHT AWAY and get his story on this high-pay, low-cost unit!

Note the vertical column in the big picture: See the high frost line. BS&B engineers designed it that way. The result is increased condensate recovery in the stock-tank. Let the hydrates work for you in producing a stable product. It's the vertical liquid height that does it. Send for the bulletin — see address below. NOW!

BLACK, SIVALLS & BRYSON, INC.

Sales Promotion Dept. Section 1-24-2SE

7502 East 12th Street Kansas City 3, Missouri

Sales Promotion Department

BLACK, SIVALLS & BRYSON, INC

7502 East 12th Street Section 1-24-

Kansas City 3, Missouri

Please rush me your new, fully-illustrated catalog o the BS&B Lo-Temperature Separator.

☐ Have Sales Engineer call.

NAME_____

FIRM_____ TITLE_____

ADDRESS_____

CITY_____ STATE_____

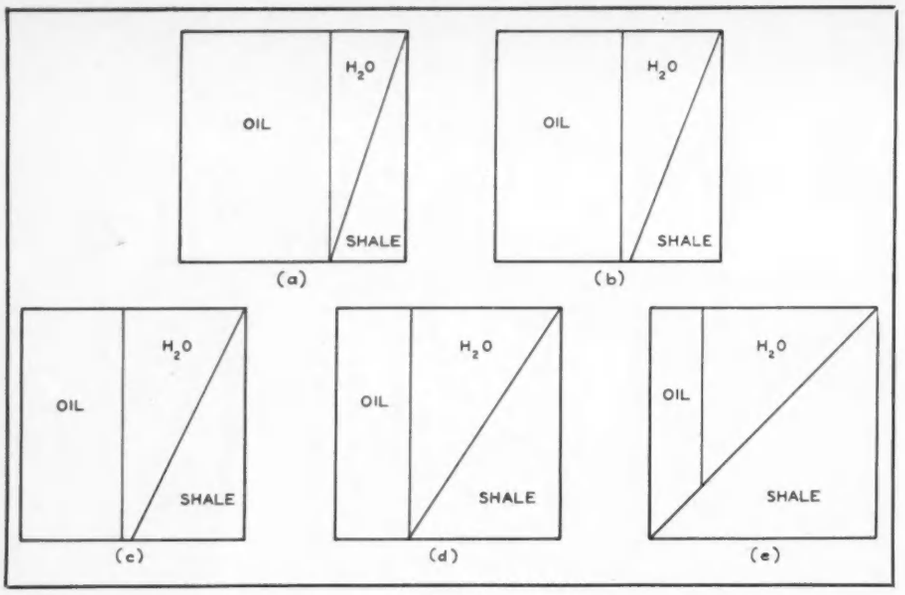


FIGURE 6. Diagrams to illustrate the probable distribution of fluid shale, water and hydrocarbons in sandstones; the permeability of diagram (e) is too low for commercial production.

dure for estimating the in-place porosity and permeability of shaly sandstones is yet to be formulated. The work of Rockwood[11] indicates some of the inherent difficulties. In all instances of fluid fines (colloids, muds, clays and/or silts) it is well known that permeability can approach zero even at high values of porosity. Pending further investigation, it is advantageous for the operator to assume that the permeability to oil or gas is commercially negligible when the ratio of fluid shale bulk volume to porosity is on the order of unity [Figures 5 and 6(e)].

Resistivity of Shaly Oil or Gas Pay

Consider an oil or gas sandstone pay which contains some fluid shale in the total space occupied by water and the fluid shale. The conductive space is $(fS + Z)$ of which $Z/(fS + Z)$ is occupied by a fluid shale having a resistivity r_s and $fS/(fS + Z)$ is occupied by water of resistivity r_w. Let r_z be the resistivity for some proportion of water and fluid shale in the space $(fS + Z)$. Then the conductivity of the mixture is defined by

$$\frac{1}{r_z} = \frac{Z}{(fS + Z)r_s} + \frac{fS}{(fS + Z)r_w}$$

from which

$$r_z = \frac{(fS + Z)r_s r_w}{Zr_w + fSr_s} \qquad (11)$$

The fraction of total space which is conductive becomes $(fS + Z)/(f + Z)$. The resistivity R_{ts} of a sandstone pay containing fluid shale is obtained with the aid of the formation factor F_t relative to the total space. Thusly,

$$R_{ts} = \frac{(fS + Z)r_s r_w}{Zr_w + fSr_s} \cdot \frac{10^{(46 \cdot f - Z)/19}}{\left(\frac{fS + Z}{f + Z}\right)^2} \qquad (12)$$

Figure 7 shows some solutions of equation (12) for 20, 40, 60 and 100 percent water saturation. The solid curves are for fluid shale resistivity equal to that of water. The dashed curves are for fluid shale resistivity equal to ten or more times that of in-place water. A sandstone pay containing 5 percent fluid shale would have to have a porosity on the order of 30 percent or more in order to have a water saturation less than 20 percent porosity.

In the case of clean sandstone pay,

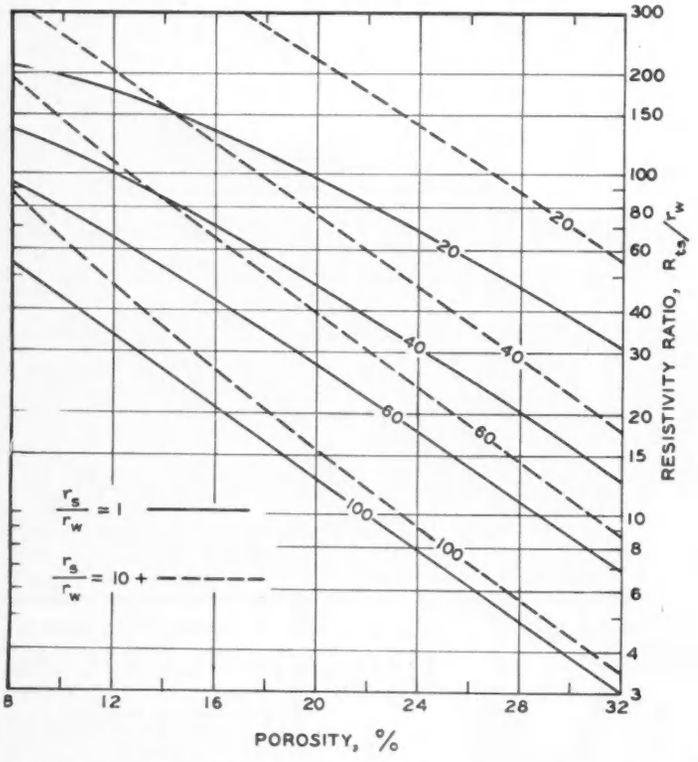


FIGURE 7. Resistivity ratio R_{ts}/r_w of sandstones containing 5 percent fluid shale and 20-100 percent water saturation.

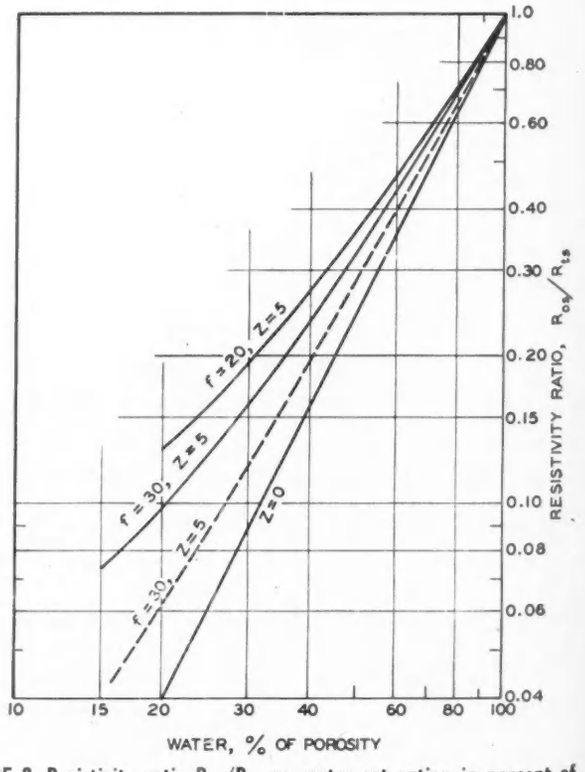


FIGURE 8. Resistivity ratio R_{os}/R_{ts} vs. water saturation in percent of porosity; for solid curves, r_s equals r_w; for the dashed curve, r_s is greater than 10 r_w.

LOOK FOR THE GREEN RODS...

POINT NO. 1 EVERY JONES SUCKER ROD...

is descaled and shot peened for added fatigue strength. A more corrosion-resistant and paint-adhering surface is also produced.

JONES

SUCKER RODS

Best in the Field!

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

THE S. M. JONES COMPANY
Division of Buffalo-Eclipse Corporation
General Office and Factory: TOLEDO, OHIO
Sales Office: Kennedy Building, Tulsa, Okla.
Export Sales Office: Buffalo International Corp.
50 Church Street, N. Y. C.

water saturation S is defined by

$$\frac{R_o}{R_t} = S^2 \qquad (13)$$

But in the case of sandstones containing fluid shale,

$$\frac{R_{os}}{R_{ts}} = \left(\frac{fS+Z}{f+Z}\right)^2 \qquad (14)$$

Equation (14) is obtained from equations (10) and (12) when $r_s/r_w = 1$. But when r_s/r_w is ten or more,

$$\frac{R_{os}}{R_{ts}} = \frac{S(fS+Z)}{f+Z} \qquad (15)$$

Figure 8 illustrates the foregoing equations. The straight line is for clean sandstone beds. The dashed curve is for a 30 percent porosity and 5 percent fluid shale of resistivity ten or more times that of the in-place water. The two solid curves are for 20 and 30 percent porosity and 5 percent fluid shale for which $r_s/r_w = 1$. The water saturation in a shaly pay is less than in a clean pay for a given long normal or lateral true resistivity. Furthermore, if one were to apply $R_{os}/R_{ts} = S^n$ where S is a fraction of porosity, the value of n would not be equal to 2.0.

Fluid and Bedded Shales in Sandstones

Many shaly oil and gas pays contain fluid and bedded shales. Bedded shales are impermeable whereas sandstone beds which do not contain an excessive quantity of fluid shale are permeable. So the microlog[13] which differentiates permeable from impermeable beds could be used to obtain the pay thickness of a thinly bedded interval.

Let y be the fraction of bedded shale in an interval for which (1 — y) is the fraction of shaly sandstone pay aside from the bedded shale. The true resistivity will be close to R_y defined by

$$R_y = \frac{R_s R_{ts}}{yR_{ts} + (1-y)R_s} \qquad (16)$$

where R_s is the resistivity of the shale beds and R_{ts} of the sandstone beds containing fluid shale, see equation (12).

Conclusions

If equation (12) were substituted for R_{ts} in equation (16), the resulting expression would be too complicated for practical purposes. On the other hand, suppose it is assumed that $r_s/r_w = 1$. This assumption may give an apparent porosity which is less than the actual porosity for a given fluid shale content (Figure 5). Now, if the apparent porosity were applied on the assumption that the fluid shale content is negligible, the estimate of water saturation (relative to the apparent porosity) would be too high (Figure 8). But on the basis of the two foregoing assumptions, R_{ts} equals R_t, y equals Z, and equation (16) reduces to equation (6). Hence, if impermeable beds can be differentiated from the permeable beds above a water contact, an estimate of the oil or gas in place with the aid of equation (6) and Figure 5 is likely to be on the conservative side. For these reasons, shaly reservoirs usually contain more in place oil and/or gas than they are credited with by electric log data not corrected for shale content. Lastly, the procedure here outlined may serve as the needed primary standard[14] for the calibration of resistivity logging devices in the field and laboratory.

SYMBOLS AND NOMENCLATURE

- f = porosity, fraction or percent of bulk volume
- f_t = total space, fraction or percent of bulk volume
- F = formation factor relative to f
- F_t = formation factor relative to f_t
- m = Archie's cementation factor
- r_s = resistivity of fluid shale
- r_w = resistivity of water
- r_z = resistivity of fluid shale and water combined
- R_o = resistivity of non-shaly beds at 100 percent water saturation
- R_{os} = resistivity of shaly beds at 100 percent water saturation
- R_s = resistivity of shale beds
- R_t = resistivity of non-shaly oil or gas pay
- R_{ts} = resistivity of shaly oil or gas pay
- R_z = resistivity of interbedded sandstone and shale beds
- S = water saturation, fraction or percent of porosity
- Z = shale content, fraction or percent of bulk volume.

REFERENCES

[1] G. E. Archie, The Electric Resistivity Log as an Aid in Determining Some Reservoir Characteristics, AIME, TP 1422, 1942.

[2] G. E. Archie, Electrical Resistivity An Aid In Core-Analysis Interpretation, AAPG Bull., Feb., 1947.

[3] G. E. Archie, Introduction to Petrophysics of Reservoir Rocks, AAPG Bull., May, 1950.

[4] M. P. Tixier, Electric Log Analysis in The Rocky Mountains, The Oil and Gas Journal, June 23, 1949.

[5] M. P. Tixier, Evaluation of Permeability From A Determination of The Resistivity Gradient On The Electric Logs, The Oil and Gas Journal, June 16, 1949.

[6] H. G. Doll, The SP Log: Theoretical Analysis and Principles of Interpretation, AIME, TP 2463, Sept., 1948.

[7] H. G. Doll, The SP Log In Shaly Sands, AIME, TP 2912, July, 1950.

[8] H. W. Patnode and M. R. J. Wyllie, The Presence of Conductive Solids In Reservoir Rocks As A Factor In Electric Log Interpretation, AIME, TP 2797, Feb., 1950.

[9] L. de Witte, Resistivity and Saturation Distribution In Infiltrated Zones of Porous Formations Around Drill Holes, The Oil and Gas Journal, July 27, 1950.

[10] L. de Witte, Relations Between Resistivities and Fluid Contents of Porous Rocks, The Oil and Gas Journal, Aug. 24, 1950.

[11] S. H. Rockwood, Analysis of Unconsolidated or Loosely Consolidated Core Samples, API, Drilling and Production Practice, 1948.

[12] Schlumberger Documents Number 2 and 3, Schlumberger Well Surveying Corp., Houston.

[13] H. G. Doll, The Microlog, A New Electrical Logging Method for Detailed Determination of Permeable Beds, AIME, TP 2880, June, 1950.

[14] Milton Williams, Estimation Of Interstitial Water From The Electric Log, AIME, TP 2936, October, 1950.

Hydrafrac Process

■ CONTINUED FROM PAGE 138

treating acid. Both fluids are displaced into the zone being treated, the gel producing a fracture and thus creating an entrance or path for the acid to enlarge. Any acid additives such as non-emulsifying agents are incorporated as in a conventional acid treatment.

The first well treated by this method was producing from the Arbuckle formation in Ellsworth County, Kansas. It had been completed in 1940 for 120 bopd but had declined to eight barrels of oil and two barrels of water. During its life a nitroglycerin shot had been applied and several acid treatments performed totaling 7000 gallons, the last of which entered the formation under well head vacuum. The combination treatment, consisting of 750 gallons of gel and 1000 gallons of acid, was performed with maximum injection pressure of 2400 psi and a minimum of 2100 psi. Production three weeks after treatment was reported as 35 bopd with no increase in water. It is believed that the viscous gel permitted the tapping of a new portion of the zone which had not been contacted by previous acid treatments.

Considerable interest is being expressed in the possible use of Hydrafrac treatments in many foreign areas. Some development work has been completed and several tests have indictated successful application. Additional work is being planned for conducting tests with both the basic Hydrafrac method and the combination Hydrafrac and acid procedure.

There is no doubt but that in the Hydrafrac process, with its variations in application, the oil industry has available another good means of increasing production. Results of the many treatments to date prove this. It is not a procedure that can be employed universally but like any other tool when properly applied, it will serve effectively in accomplishing the purposes for which it is intended. It is believed that careful well preparation and well completion technique, based on thorough formation analysis, will lead to a wider use of the process in the future, resulting in greater recovery of oil and gas reserves, a need which is becoming increasingly evident.

ACKNOWLEDGMENTS

The author expresses his thanks to the various division engineers of Halliburton Oil Well Cementing Company, who furnished information used in the paper, and to Wm. D. Owsley and C. E. Clason of the same company for their assistance. Appreciation is expressed to the management of Halliburton Oil Well Cementing Company for permission to present this paper.

SONOSCOPE

OILFIELD TUBULAR INSPECTION

. . . the only scientifically accurate method of oilfield drill pipe inspection in the field

SONOSCOPE combines ultrasonics, magnetics, and electronics into a vastly superior and more economical inspection method in which the human element is eliminated. With SONOSCOPE not only are physical discontinuities determined and evaluated, but variations in the internal structure of the metal itself are located accurately and recorded in permanent graph form.

SONOSCOPE not only prevents costly failures from occurring in drill pipe, but it also eliminates the waste of discarding pipe which is still serviceable. With unmatched precision in the non-destructive testing of oilfield pipe, SONOSCOPE permits a scientific estimate to be made of the future useful life of each length of pipe.

Further details are available on request.

Tuboscope
OILFIELD TUBULAR INSPECTION

Division of

TUBULAR SERVICE & ENGINEERING COMPANY

COMMERCE BUILDING • HOUSTON, TEXAS

Open Flow Potential Calculation For Dual Completion Wells

By C. W. BINCKLEY and W. L. HIXON

Phillips Petroleum Company, Bartlesville, Okla. Anderson-Prichard Oil Corporation, Oklahoma City

THE AUTHORS, confronted with the problem of determining flow conditions through an annulus surrounding two unequal pipes in a well casing, develop a formula which, with certain assumptions, provides a means of calculating flow under actual well conditions and thus provides a basis for equitable allocation of flow values to the two zones of a dual completion.

DURING the latter part of 1949 Anderson-Prichard Oil Corporation dually completed three wells in an unusual manner in the west portion of the Fourdee field, Noble County, Oklahoma, four miles west and five miles north of Perry. These wells produce from a Bartlesville gas stringer found at 4660-700 feet and the Mississippi lime oil zone approximately 120 feet deeper. Two strings of tubing side by side are employed inside the casing string, making necessary the development of an equivalent diameter formula in order to properly calculate the open flow potential of the gas zone produced through the annular space.

The Fourdee field, which takes its name from the local schoolhouse designated by the sign "4-D," was discovered in August, 1946, when Midland Cooperative Refining and Eason Oil Company completed Carter-Boyes 1 in the Mississippi lime. In March, 1949, Midland and Eason discovered the Bartlesville zone in Hughes 1 and completed a gas well with an initial open flow potential estimated in excess of 100 Mmcf per day. This discovery in the west portion of the field, which was not encouraging for further Mississippi lime development, led to the completion of eight additional Bartlesville gassers. As may be seen on Figure 1, four of the wells are single completions and five are dual completions, three of which, owned by Anderson-Prichard, have the unusual combination tubing strings.

All of the Apoc dual completions are similar in method and equipment. Figure 2 is a schematic drawing of the Wattles 4 in the SW quarter of Sec. 24, which was completed and equipped below surface as follows:

- 175 feet of 9⅝-inch 40-pound Grade D surface casing set at 185 feet with 175 sacks.
- 4907 feet of 5½-inch 15.5-pound J-55 casing set at 4886 feet with 200 sacks.
- Perforated 4823 to 4853 feet with three ½-inch jet holes per foot (Mississippi lime).
- Perforated 4700 to 4732 feet with eight ½-inch jet holes per foot (Bartlesville).
- Set retainer production packer at 4793 feet.
- Ran the following equipment (top to bottom:
  - (a) 2⅜-inch OD EUE tubing set at 4793 with side-door nipple and choke above packer and also with 1-inch hydraulic pumping tubing side by side.
  - (b) Change-over flow tube with the by-pass sub modified as follows: (1) blank below tubing box threads cut out; (2) normal bypass ports sealed; and (3) connection for one-inch tubing made slightly below these sealed ports. This modification, on which a patent is pending, permits flow through the inner tube on up the two-inch tubing and flow into the one-inch tubing from the lower ports and the annulus between the inner and outer tubes.
  - (c) Anchor of one-inch line pipe with bottom ten feet perforated set at 4843 feet.

The purpose of having the one-inch tubing string side by side with the two-inch tubing in these wells is twofold. First, it will permit a longer flowing life for the Mississippi zone; and second, by acting as a bleeder, it will prevent gas locking when it becomes necessary to pump the lower zone. To use the small tubing to jet the oil from the lower zone employing for such purpose the high-pressure Bartlesville gas was estimated to be uneconomic as compared to beam pump operation.

In order to comply with Oklahoma regulations providing for ratable taking of gas from the common source of supply, it became necessary to obtain open-flow potentials on the Bartlesville gas wells. Representatives of the Oklahoma Corporation Commission were called upon to supervise much of the testing and to assist in the calculation of the final results. It was at once apparent that no formula existed which would enable a mathematical or theoretical determination of the friction loss due to two strings of tubing side by side inside a casing string with gas flow in the annular space. Such a determination was a prerequisite to the back pressure open flow calculation. Of course, one alternative existed—the setting of a plug in the side-door choke nipple below the ports and flowing the Bartlesville sand gas through the two-inch tubing with the one-inch closed; however, this would have resulted in a substantial expense to the operator. After several engineers considered the problem, a formula was developed by which the flowing friction computations could be made. The development of the formula and its application will be discussed in the following paragraphs.

In order to determine absolute back

pressure potentials for gas wells it is necessary to compute flowing friction losses in the pipes through which the gas flows. When wells are completed with two flow strings side by side within a casing and gas flows through the casing, it is advisable to use an equivalent diameter for the flow system for substitution in the diameter terms in any of the generally used flow equations to compute flowing friction losses.

A theoretical approach is given herein for the determination of an equivalent diameter to be used in the general gas flow equation, in which the coefficient of friction is that of Drew and Genereaux. Such equation has been used by the Conservation department of the Oklahoma Corporation Commission for several years in the determination of flowing friction losses in gas well flow strings.

The general flow equation for gas in a pipe line:[1]

$$Q = K \frac{T_o}{P_o} \left[\frac{(P_1^2 - P_2^2)\, d^5}{GTL_f} \right]^{1/2} \qquad (1)$$

Where: Q = Volume of gas in cubic feet per hour at pressure base P_o and temperature base T_o.
K = Numerical constant
T_o = Temperature base, °F abs.
P_o = Pressure base, Psia
P_1 = Inlet pressure, Psia
P_2 = Outlet pressure, Psia
d = Internal pipe diameter, inches
G = Specific gravity of gas (air = 1.000)
T = Temperature of flowing gas, °F abs.
L = Length of pipe in miles
f = Coefficient of friction, no units

In the development of equation (1) the terms of cross-sectional area and perimeter of the flow string are absorbed in the constant K and the d^5 term. For determination of the flow equation for a particular combination of tubing within a casing it is necessary to replace the flow string area and perimeter in equation (1):

$$Q = k \left[\frac{(P_1^2 - P_2^2)\ \ \frac{(d^2\pi)^3}{4}}{LGTf\,(d\pi)} \right]^{1/2} \qquad (2)$$

k is a new constant including the temperature and pressure bases.

The Reynolds Number criterion for the flow of fluids is:

$$R_e = \frac{4mUS}{\frac{Z}{L}} \qquad (3)$$

Where: m = Hydraulic Radius = $\frac{\text{Cross Sectional Area of Flow Channel}}{\text{Perimeter of Flow Channel}}$
U = Velocity of gas flowing, ft./sec.
S = Density of gas at flowing conditions, lbs./cu. ft.
$\frac{Z}{L}$ = Viscosity of gas, lbs./ft.-sec.

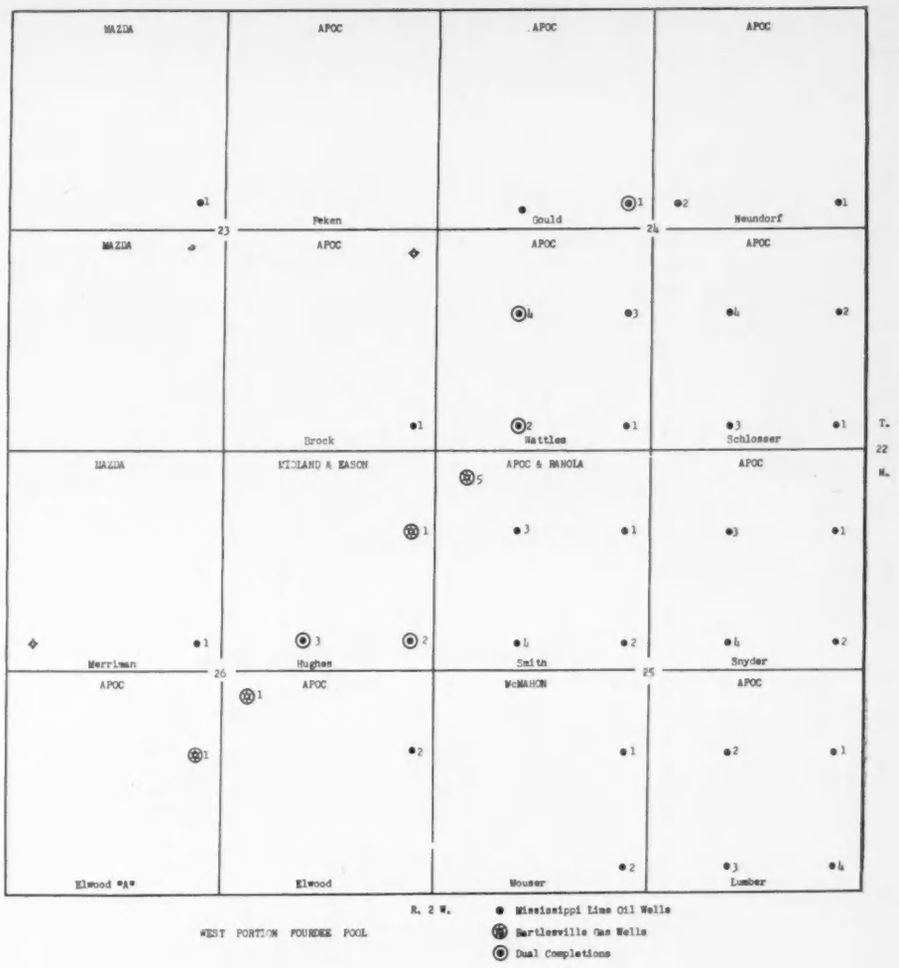


FIGURE 1.

For the flow system with two tubing strings side by side in a casing the hydraulic radius term is:

$$\frac{\text{Cross-sectional Area}}{\text{Perimeter}} = \frac{(d_1^2 - d_2^2 - d_3^2)\ \frac{\pi}{4 \times 144}}{(d_1 + d_2 + d_3)\ \pi/12} \qquad (4)$$

or

$$m = \frac{(d_1^2 - d_2^2 - d_3^2)}{48\,(d_1 + d_2 + d_3)} \qquad (5)$$

Where: d_1 = Inside diameter of casing, in.
d_2 = Outside diameter of tubing No. 1, in.
d_3 = Outside diameter of tubing No. 2, in.

The velocity term, U may be expressed as:

$$U = Q \times \frac{P_o}{P_a} \times \frac{T}{T_o} \times \frac{4 \times 144}{\pi\,(d_1^2 - d_2^2 - d_3^2) \times 3600} \qquad (6)$$

or

$$U = \frac{Q \times P_o \times T \times .0509}{P_a \times T_o \times (d_1^2 - d_2^2 - d_3^2)} \qquad (7)$$

where P_a = Average flowing pressure, psia

The density, S may be expressed as:

$$S = \frac{.08071 \times G \times P_a \times 492}{760 \times .01934 \times T} \qquad (8)$$

Where:
.08071 lbs./cu. ft. is density of air at 760mm of mercury and 32° F.
.01934 is a conversion factor to convert mm of mercury to lbs./sq. in.

Then by combining terms

$$S = \frac{2.699\ G\ P_a}{T} \qquad (9)$$

The viscosity term $\frac{Z}{L}$ can be taken as 7×10^{-6} lbs./ft.-sec. By substituting all of the above terms of the Reynolds Number into equation (3), simplifying, and substituting the values of 14.65 Psia for the pressure base and 60° F. (520° F. abs.) for the temperature base, we obtain the Reynolds Number for gas flowing around the two tubing strings in the casing.

$$R_e = \frac{46.15\ QG}{d_1 + d_2 + d_3} \qquad (10)$$

The Drew and Genereaux Coefficient of friction[2], for round pipe is defined as:

$$f = .03015\ R_e^{-0.1505} \qquad (11)$$

The friction factor for the flow system under consideration is found by

substituting the value of R_e in equation (10) into equation (11) or:

$$f = .03015 \left[\frac{46.15\ QG}{d_1 + d_2 + d_3} \right]^{-0.1505} \quad (12)$$

We obtain the equation for the flow of gas around the two tubing strings inside the casing, using the Drew and Genereaux coefficient of friction, by substituting the value of f in equation (12) into equation (2) and by inserting the values of cross sectional area and perimeter for the system into equation (2) the result is:

$$Q = k \left[\frac{(P_1^2 - P_2^2)\ (d_1^2 - d_2^2 - d_3^2)^3}{GTL\ (QG)^{-0.1505}\ (d_1 + d_2 + d_3)^{1.1505}} \right]^{1/2} \quad (13)$$

We obtain the equation for the flow of gas in plain pipe by substitution of the value of f in equation (11) into equation (2) and the result is:

$$Q = k_1 \left[\frac{(P_1^2 - P_2^2)\ d^{4.8494}}{GTL\ (QG)^{-0.1505}} \right]^{1/2} \quad (14)$$

It is now obvious that the equivalent diameter, d_e to be used in place of d in the plain pipe equation (14) is:

$$d_e^{4.8494} = \frac{(d_1^2 - d_2^2 - d_3^2)^3}{(d_1 + d_2 + d_3)^{1.1505}} \quad (15)$$

or:

$$d_e = \frac{(d_1^2 - d_2^2 - d_3^2)^{.619}}{(d_1 + d_2 + d_3)^{.237}} \quad (16)$$

It is believed the equivalent diameter developed herein is satisfactory for the computation of flowing friction loss in connection with the determination of gas well back pressure absolute potentials. However, it should be remembered that no allowance has been made for pipe joints (upsets) in the tubing string. It is assumed that the outside surfaces of the tubing strings are similar to the inside casing surface in so far as the resistance to the flow of gas is concerned. This assumption may not be true.

To test the accuracy of the assumption used in the equivalent diameter development and the applicability of the Drew and Genereaux coefficient of friction to the flow of gas through a casing and around two tubing strings, experimental field tests must be made. By use of equation (2) and reliable pressures and rates of flow data for several wells, experimental coefficients of friction can be determined. By use of equation (10) the corresponding Reynolds Number for each coefficient of friction can be established. If a plot of Reynolds Numbers versus the coefficients of friction results in a relationship essentially the same as defined by equation (12) the Drew and Genereaux coefficient of friction is applicable and the method of computing the equivalent

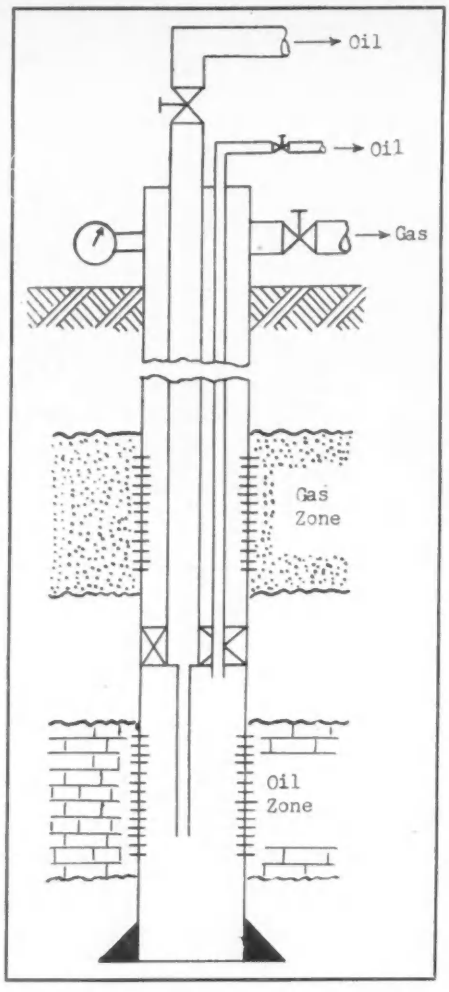


FIGURE 2. Schematic drawing of Apoc Dual Completion.

FIGURE 3. Anderson-Prichard's Wattles 2, showing wellhead equipment used in unusual dual completion.

diameter developed in this paper is reliable.

Undoubtedly, the application of the formula (16) may best be illustrated through example. The Wattles No. 4 provides the following basic data:

$d_1 = 4.950''$ for $5\frac{1}{2}''$ 15.5# casing
$d_2 = 2.375''$ for $2''$ 4.7# EUE tubing
$d_3 = 1.315''$ for $1''$ 1.7# tubing

By substituting in the formula, using logarithms and simplifying we may calculate d_e to be $3.5015''$. This is the equivalent diameter of the annular space through which the Bartlesville gas is produced. The diameter, d_e, is now available for use in computing the friction loss occurring in the well due to flow.

The Conservation department of the Oklahoma Corporation Commission generally uses the following formula to determine the back pressure open-flow potential of a gas well on one-point test.

$$O.F.P. = Q_1 \left[\frac{P_c^2}{P_c^2 - (P_w^2 + AB)} \right]^{0.85} \quad (17)$$

Where: O.F.P. = Open-flow potential in cubic feet per day.
P_c = Shut in pressure, Psia
P_w = Working pressure, Psia
AB = Friction factor
Q_1 = Rate of flow in cubic feet per day

The rate of flow factor, Q_1 can be expressed as

$$Q_1 = C\ (Ph_w)^{1/2} \quad (18)$$

Where: C = 24-hr. orifice coefficient at 14.65 psia pressure base corrected for temperature and specific gravity
P = Static pressure, Psia
h_w = Differential pressure, Inches of water

The friction factor, AB, is the product of the values "A" and "B" which may be found in Oklahoma Conservation Department tables.

$$A = \frac{10{,}000\ (T)^2\ (E^S - 1)}{38{,}857\ (G)^{.1506}\ (d_e)^{4.8494}\ (E^S)} \quad (19)$$

Where: T = Temperature of flowing gas, °F abs.
G = Specific gravity of gas
d_e = Equivalent diameter, as above determined
E = Napierian log base, 2.718—and the value, S, which is determined from

$$S = \frac{.0375\ (GL)}{TZ} \quad (20)$$

Where: L = distance (feet) from surface to approximate midpoint of producing zone.
Z = Supercompressibility factor

$$B = \frac{(Q)_2^{1.8494}}{10{,}000} \quad (21)$$

Where: Q_2 = Rate of flow in MCF per day.

It may be recognized that for any

well the "A" value can be firmly established for use in open flow potential calculations. While other values substituted in equation (17) vary from test to test, the "A" value will remain fixed for all practical purposes. With an equivalent diameter of 3.5015 inches the "A" value for the Wattles No. 4 may be calculated (19) to be 35.24, using 540° F. absolute flowing temperature (T), 0.65 specific gravity (G), 4716 feet (L) and ignoring supercompressibility (Z).

REFERENCES

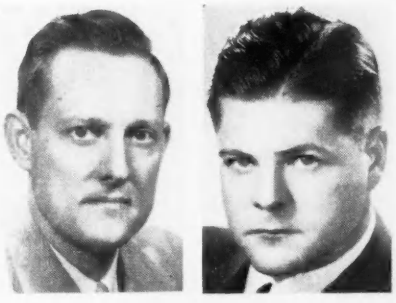
[1] U. S. Department of Interior, Bureau of Mines, Monograph 6, "Flow of Natural Gas Through High Pressure Transmission Lines." Appendix I, Equation No. 23.

[2] High-Pressure Pipeline Research, Project No. 49, Clark Bros. Co., Inc., Olean, N. Y. Fig. 12, p. 40. Copyright, 1942.

ACKNOWLEDGMENT

The authors are grateful to the respective managements of the Phillips Petroleum Company and the Anderson-Prichard Oil Corporation for permission to prepare this paper. Also they are grateful for the assistance and advice so generously given by Elmer Capshaw of the Conservation Department of the Oklahoma Corporation Commission.

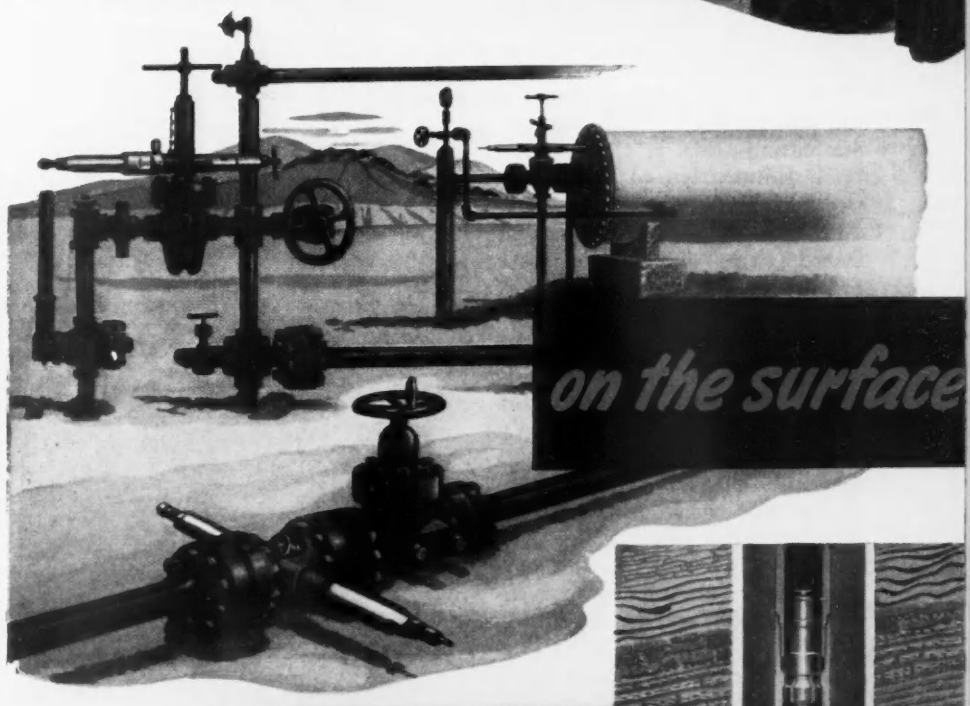
About the Authors



Binckley Hixon

C. W. BINKLEY, staff director in charge of Production and Allocation for the Gas Division of Phillips Petroleum Company, graduated from Oklahoma University in 1936 with a B.S. degree in mechanical engineering. Following graduation he served as roustabout, junior manufacturing engineer, engineer, gas engineer and staff director, all with Phillips, in the line of oil, natural gas and gasoline reserves, gas reservoir engineering and production and allocation of natural gas. He is a registered engineer in the state of Oklahoma.

W. L. HIXON was born in Minneapolis, December 2, 1918. He attended the University of Oklahoma and was graduated in June, 1942, with a B.S. degree in Petroleum Engineering. Until January, 1947, when he joined Anderson-Prichard Oil Corporation, he served in the Navy. He is in the company's Production department.



and in the hole

PRESSURE CONTROL OTIS SERVICE - EQUIPMENT

Otis Safety Valves

There's an Otis AUTOMATIC *Safety Valve for every high-pressure condition... surface or sub-surface... for installation on existing tree fittings... for seating in previously-installed Otis Landing Nipples, or in strings without landing nipples. Contact one of these Otis offices for complete details—*

DALLAS • HOUSTON • CORPUS CHRISTI • VICTORIA • FALFURRIAS • LONGVIEW • ODESSA
OKLAHOMA CITY • NEW IBERIA, LOUISIANA • HOUMA, LOUISIANA • BROOKHAVEN, MISSISSIPPI

OTIS PRESSURE CONTROL, INC. • BOX 7206 • TWX DL-220 • DALLAS

Protection of Well Casings Against EXTERNAL CORROSION

By
R. E. HAMMOND
and
S. P. EWING
The Carter Oil Company
Mattoon, Ill.

OBSERVATION OF numerous casing leaks in the Loudon pool, Illinois, led to a research program to determine the cause and cure of this trouble. It was found that the leaks were caused by external corrosion of the casing in an area where the casing passed through the Tar Springs formation, a permeable salt water sand overlying the producing zones. It was established that more than 90 percent of this corrosion was caused by electrolytic currents flowing down the casing from the flow line. To stop this corrosion, the current flow was interrupted by placing insulating nipples or flanges between flow lines and casings. Leak records before and after these insulators were installed show that most of the leaks have been stopped by these insulators. Estimates based on lead records on 1280 wells before and after insulation indicate that the insulation, which cost $36,000, has resulted in a net saving of about $160,000 during the four years the insulation has been in effect. The ultimate saving for this group of wells is estimated to be $1,700,000.

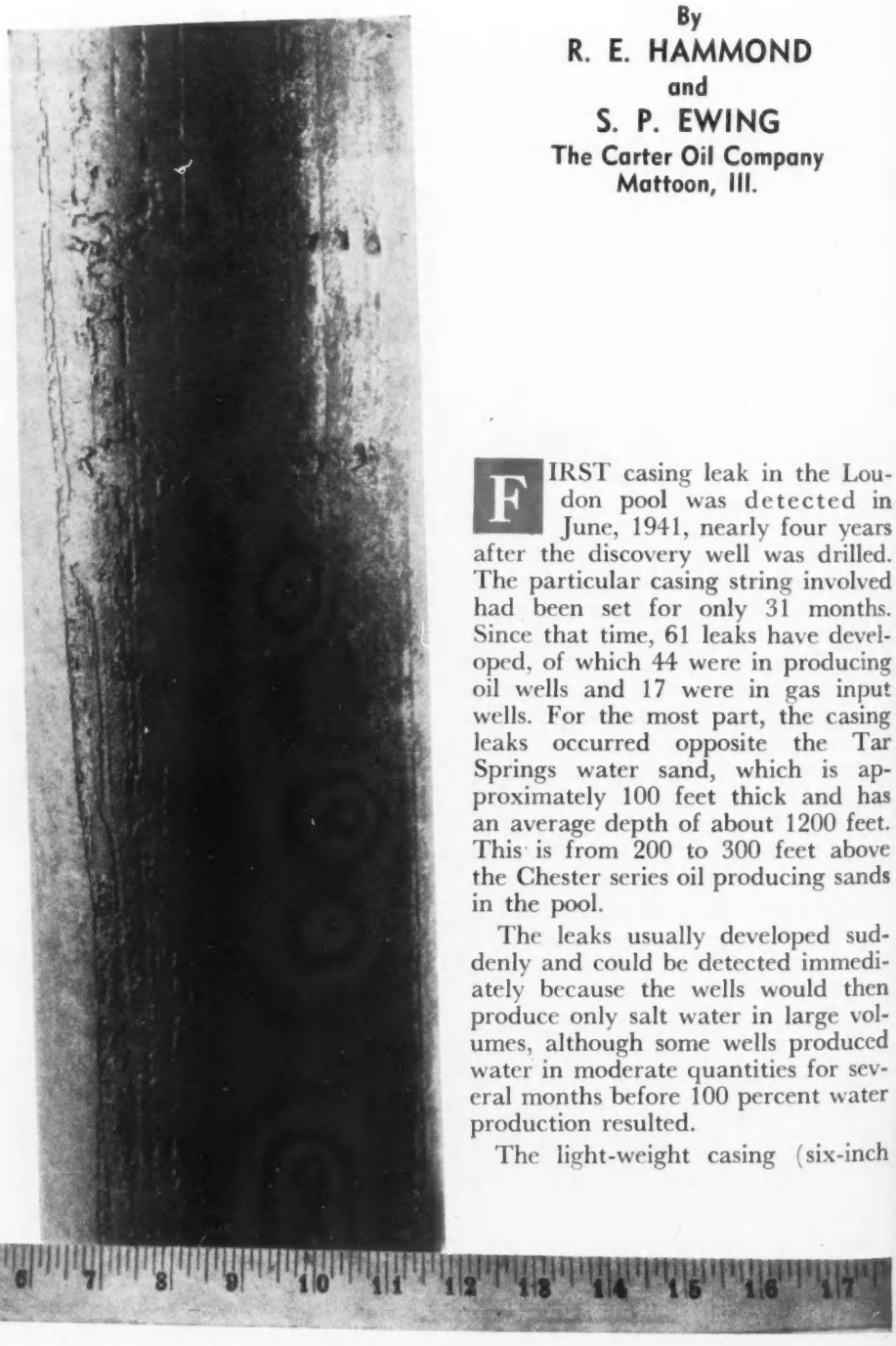


FIGURE 1. Typical appearance of casing from Tar Springs sand.

FIRST casing leak in the Loudon pool was detected in June, 1941, nearly four years after the discovery well was drilled. The particular casing string involved had been set for only 31 months. Since that time, 61 leaks have developed, of which 44 were in producing oil wells and 17 were in gas input wells. For the most part, the casing leaks occurred opposite the Tar Springs water sand, which is approximately 100 feet thick and has an average depth of about 1200 feet. This is from 200 to 300 feet above the Chester series oil producing sands in the pool.

The leaks usually developed suddenly and could be detected immediately because the wells would then produce only salt water in large volumes, although some wells produced water in moderate quantities for several months before 100 percent water production resulted.

The light-weight casing (six-inch

outside diameter, 14-pound welded) was cemented to the surface. The presence of cement back of the full length of casing confines corrosion to relatively small unprotected areas of the pipe where there are breaks in the cement. The unusually extensive system of surface lines which provides a large cathodic area may have made the corrosion rate abnormally high.

The repair of casing leaks has usually been accomplished by squeeze cementing. By this process 33 producing wells and 13 gas input wells have been repaired at an average cost of $2330. Three input wells and one producing well have been repaired by cementing a liner through the Tar Springs section at an average cost of $5500, and eight producing wells and one input well were repaired by setting a tubing packer below the leak at an average cost of $175. Two wells were such small producers that repair of the casing leak was not economically justified, so abandonment was necessary at an average additional expense of $185. The average repair cost for each of the 61 wells was $2149.

Main Cause of Corrosion

The investigation of casing leaks at Loudon was instituted in 1942. Tests of various types over a period of two years showed a flow of current in flow line and down the casing. The final step of this investigation involved the removal of one casing string which had developed a leak, and visual examination of the pipe removed confirmed the theory of galvanic corrosion resulting from differential aeration of flow line and casing. Figures 1 and 2 show the external appearance of casing exposed to the Tar Springs sand. As a result of determining the cause of casing corrosion and because of the increasing frequency of casing failures, a field-wide program of casing insulation was instituted in March, 1945. Synthane plastic nipples six inches long were installed in the flow line at the wellhead on all producing wells at an average cost of $9.30 per well. Insulating flanges were also installed near all gas input wells at an average cost of $20 per well. This insulation program at Loudon was completed in October, 1946. It resulted in an increase in flow line potentials with respect to calomel of about 0.2 volt, from an average of —0.7 to —0.5.

In Figure 3, accumulated casing leaks are plotted against the average age on log-log paper. The fact that the insulation program has been effective in preventing casing leaks is clearly indicated by the sharp change of slope of the curve. The curve can be used to make an estimate of ultimate benefits to be derived from the insulation program. The justification of this chart is discussed further. On the basis of the failure trend established before insulation was started, it is estimated that approximately 900 casing leaks would have developed by 1970, or that about 31 more leaks may develop in the future if insulation only is used as a preventive measure.

Design of a Cathodic Protection System

A. Current Requirements and Anode Location

At the time insulation was installed, there was no conclusive evidence that the future leak frequency would be reduced to the extent indicated by field test measurements, which showed a reduction of about 90 percent in the casing currents. It was therefore decided to inaugurate cathodic protection tests on a few wells to determine whether the casing could be protected by this means, and if so, to work out the most effective method and to determine costs. Thus, when the trend of the leak curve after insulation became known, reliable data on cost of cathodic protection would be available, and the advisability of a general cathodic protection program could be determined. It appears that cathodic protection is not now needed to control leaks in this pool, but it may be needed at a later time, or it may be necessary in other pools.

Before cathodic protection could be installed, it was necessary to determine where the anodes should be placed and the amount of current which would be needed in order to have sufficient current density over the entire length of the casing. The technical details of the cathodic protection problem on well casings have been more completely discussed in a previous publication.[1] Measurements on a few of the surface pipe lines showed that these lines could not be used effectively as part of the return circuit if an attempt were made to protect several wells with one anode and one rectifier, but it was felt that protection of surface lines was not mandatory since few leaks had occurred in this pipe system. There is considerable advantage in using a separate rectifier unit for each well, as all of these units could be exactly the same and thereby reduce costs and operating problems. Electric power is available at all producing wells. In general, there is less congestion of surface pipe lines near the wells than near tank batteries, and so there would be less interference if the anode were placed near the well.

Current requirements and anode locations were investigated by measuring voltage drops in the casing with a double contact probe. The current flow along the casing was measured with no applied current and also with various amounts of applied current from anodes at various distances from several typical wells. Current requirements were also estimated by means of current-potential curves on the casings. The results of these measurements showed that no improvement in current distribution on the casing could be obtained by placing the anode more than 200 feet from the well head. Both the IR drop measurements and the current-potential curves indicated that about 1.5 amperes were needed to protect the entire length of the 1500-foot casings. This is equivalent to an average cur-

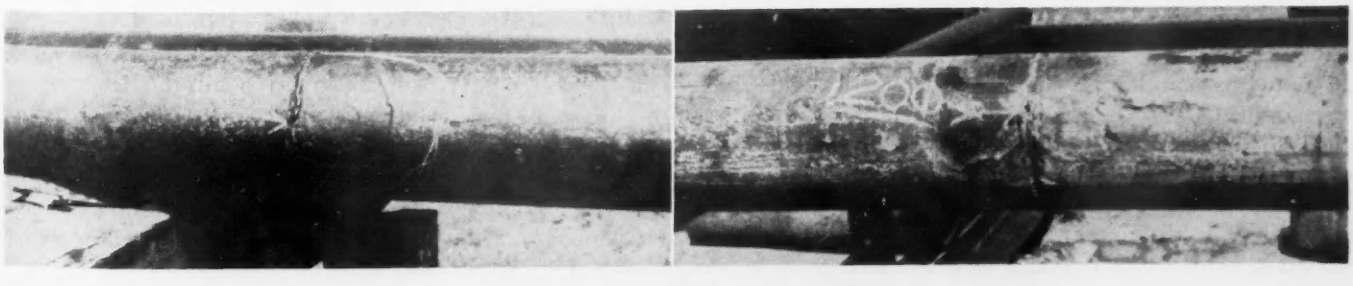


FIGURE 2. Appearance of two casing leaks.

rent density of 0.65 milliamperes per square foot.

B. Installation of Experimental Rectifier Units

Ten wells were arbitrarily selected to include all parts of the pool and all types of wells, the only consideration being reasonable accessibility at all times. These included two 3000-foot Devonian wells, and two Chester sand gas input wells. Since there is a rather congested network of pipe lines over the pool, maps were prepared showing all pipe lines in areas 1000 feet square around each well. Soil resistivity measurements were made with the four terminal Biddle megger, using a ten-foot span between adjacent earth contacts at various places in the vicinity of the wells where anodes might be located. In this way a location for the anode was selected which would not seriously affect the pipe lines, and which had the lowest possible resistivity. From the resistivity measurements and consideration of expected current discharge and service life, 45 feet of four-inch pipe buried at a depth of three feet was chosen as the standard anode. It was felt that with this anode it would always be possible, by addition of salt or coke to the backfill, to obtain an anode resistance as low as four ohms so that at least 1.5 amperes would be delivered by a six-volt rectifier.

One hundred pounds of salt was added to the backfill where the calculated anode resistance was above three ohms. The rectifiers were of the full wave magnesium-copper sulfide type, rated 3.9 amperes and 6.8 volts at 40° C. Taps were provided to vary the voltage between three and six volts, and instrument terminals were available so that the output of each rectifier could be measured. The rectifiers were mounted on the power pole where the motor control cabinet for the pumping unit is located, and insulated. No. 12 solid conductor wire was buried in trenches leading to anode and casing head.

Current-potential curves were made on all the wells before protective current was applied. Similar curves were made after the units had been in operation three months, the rectifiers being turned off approximately 24 hours previously to making the measurements for the second set of curves. In each case, these curves were very similar in shape to the original curves, but the potentials were all shifted in the anodic (negative) direction by varying amounts up to 0.2 volt.

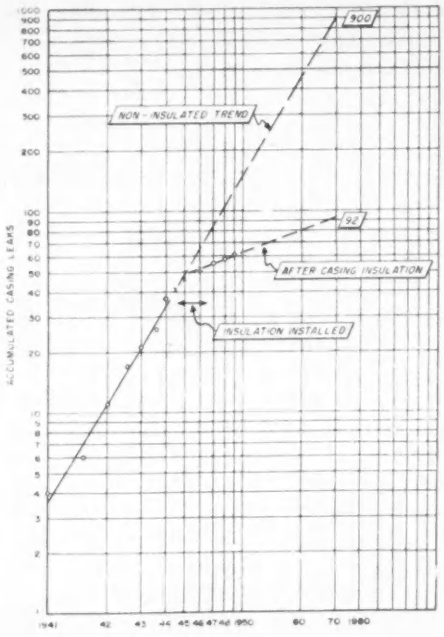


FIGURE 3. Summary of casing leaks in the Loudon pool.

C. Magnesium Anodes

Magnesium anodes were installed on two wells to test their application to cathodic casing protection. These installations might not be considered an entirely fair test of magnesium since the ten anodes installed at one well were placed only ten feet apart or too close to each other for maximum output. Five anodes spaced 25 feet apart were attached to the other well. Although the total output of the 17-pound anodes was only about 0.13 ampere at each well, in a period of six months the potential of one well casing had been increased to 1.02 volts from an initial value of 0.67 volt against saturated calomel. A current-potential curve made on this well after the magnesium had been connected for 10 months showed no indication of a change in slope below 1.0 ampere. It is believed that one ampere is needed to prevent the corrosion of this casing even though a current of 0.13 ampere changed its potential by —0.35 volt. There have been no failures or difficulties in the operation of the magnesium anodes.

Performance of Rectifier Units

The units were installed in July, 1948, and they were inspected at approximately monthly intervals over a period of two years. At each inspection measurements were made of rectifier current and voltage, potential of the well casing and flow line with respect to a calomel electrode placed at least 75 feet from the well with the anode circuit both closed and opened, and the potential between flow line and casing with the anode circuit opened. If any failure of equipment was found, it was corrected as soon as possible. A brief summary of some of these measurements and observations follows.

The original open circuit potentials of the casings with respect to a saturated calomel electrode varied from 0.66 to 0.85 volt, and averaged 0.75 volt. The application of protective current caused a change in the open circuit casing potentials of roughly 0.25 volt after one week, and thereafter the potential of most of the wells was near 1.0 volt. During the past few months, and when the anode resistance has not been too high, the potentials have been close to 1.1 volts.

Principal source of difficulty in obtaining proper rectifier output is the rather large error in the predicted resistance of the anodes and the wide fluctuations observed in anode circuit resistance. For the eight and ten-foot megger spans there was no correlation between the calculated and observed anode resistances and the four-foot span of the megger terminals was found to be the best for predicting anode resistance. A comparison of resistance calculated from the four-foot span resistivity with actual observed resistance is shown in Figure 4. The vertical lines show the range in anode resistance observed over a period of two years at each installation. The resistance is calculated from the rectifier output and thus includes the resistance of the wire, which is never over 0.5 ohm. Most anodes had minimum resistivity during July, 1948, while six of the ten anodes showed their highest resistance in the fall of 1948 during an exceptionally dry period. The other maxima occurred at various other times. The resistance seemed to gradually build up to a high value, and often at this time the anode wire broke, due to corrosion. After the wire was repaired, the resistance usually was found to be considerably lower. None of these maxima appears on the magesium installations. Over most of the time the anode resistances were at reasonably low values, and these average values are shown as points on the vertical lines. It is seen that in most cases there is fair correlation between these values and the calculated resistance. The addition of salt to the backfill may be the reason for the low values of observed resistance.

It does not seem reasonable to at-

It doesn't have to be this way...

"RED, GET TO THE C. RUBEL LEASE, FIRST... PARAFFIN'S GOT 5 AND 9... ROD'S BROKE IN 7 ... DON'T KNOW WHEN WE CAN GET TO THE BRADDOCK TO PULL 3 AND 6, ROAD IN THE BOTTOMS IS STILL UNDER WATER. TOMORROW WE'LL TRY AND PULL THE TWO WELLS ON THE GLENNIS—SO IF YOU CAN GET THROUGH FROM THE RUBEL, DRIVE THE RIG TO GLENNIS 3...ETC..."
It can be like this!
"IF ANYBODY CALLS, RED, I WON'T BE AWAY LONG ... I'M JUST GOING OUT TO SEE A FEW OF THE PUMPERS... HARDLY EVER HEAR FROM THEM SINCE WE PUT IN THOSE FREE PUMPS!"

...Free Pumping Makes the Difference!

Troubles don't have to come by the dozen! You don't have to be dependent upon the availability of pulling equipment to change a faltering bottom hole pump! You don't have to call out the gang to "bust out" paraffined lines!

You *can* escape these worrisome problems and have time to plan your lease development program—*if your lease is Free Pumped.*

Your pumper alone can surface and run in the bottom hole Free Pump. He needs only to turn a valve to clean paraffin out of the lease lines and well tubing. Free Pumping makes him independent of outside help and enables you to put more oil in the tanks at a lower cost.

To convert your lease to Free Pumping, call your nearest Kobe representative. He will be glad to give you a detailed estimate.

Free Pump
KOBE
ONE OF THE DRESSER INDUSTRIES

KOBE, INC. *General Offices:* Huntington Park, California. *Division* and *District Offices:* Avenal, Bakersfield, Huntington Park and Ventura, California; Great Bend, Kansas; Hobbs, New Mexico; Healdton, Oklahoma City, Tulsa, Oklahoma; Brownfield, Corpus Christi, Fort Worth, Houston, Kilgore, Odessa, Texas; Casper, Wyoming; New York City.

tribute the peaks in the anode resistance curves to thinning of the anode wire because in some cases the resistance returned to its normal value. Neither does it seem reasonable to attribute it entirely to drying of the soil, although this is no doubt part of the cause, as it is unlikely that the moisture content at three feet would drop to about one-third of its normal value. It is believed that electric endosmosis and slight heating of the soil in the immediate vicinity of the anode may be the cause of the high observed resistances. Of course, the obvious remedy is to bury the anodes at greater depth or provide some other means to keep the moisture content higher around the anode.

During the two-year period, the covered wires were broken 24 times because of insulation failures. In two cases plows broke the wires because they were not placed at sufficient depth. In 15 cases fuses were blown, and there were four other electrical faults, one of which was a burned-out transformer. The maintenance of the rectifiers have averaged 72 cents per unit per month, but this could be reduced by at least one-half if wire failures were eliminated. Practically all the wire breaks occurred where heavy equipment had passed over the wire. The insulated wire would probably be satisfactory if protected from mechanical damage. The cost of electrical energy averaged 15 cents per unit per month.

Economic Comparison of Methods

In order to analyze the economics of corrosion preventive measures adopted at Loudon, it is obvious that certain assumptions must be made regarding future leaks and future repair costs, and that different assumptions are likely to lead to different conclusions. It is the purpose of the authors to be conservative in these assumptions and to recommend expenditures only when it is reasonably certain that a profitable investment will result.

Choice of coordinate scales in the chart of Figure 3 is based on observations of pit depths on pipe samples buried in the soil, and on experience with leaks on pipe lines.[2] The abscissa on this chart should be the age of the casings rather than the age of the field as a whole, but this adjustment would have a minor effect on the leak curve since nearly all the wells were completed in less than three years. The plotting method used permits more definite future estimates since

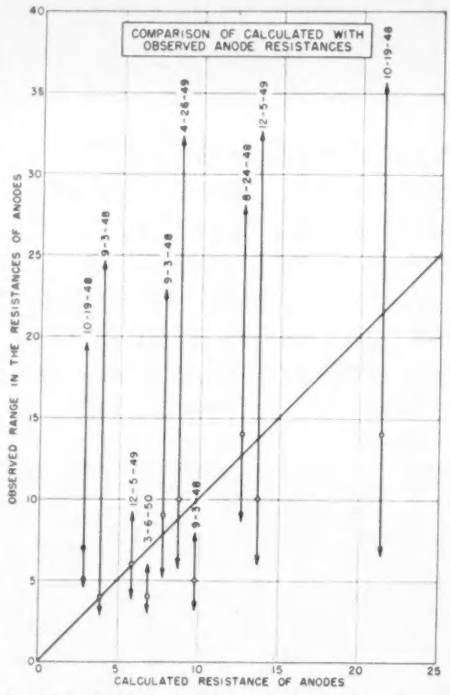


FIGURE 4. Calculated resistance of anodes.

the more recent points are not subject to further adjustment.

The casing insulation program adopted at Loudon has cost approximately $36,000 including the field testing and casing recovery, and has already resulted in eliminating approximately 69 leaks. Cost of repairing these leaks would have been approximately $142,000, and the ultimate cost of repairing the 900 leaks as estimated in Figure 3 would be $1,904,000. Hence there is no question as to the value of the insulation in reducing leaks to an expected total of 92, of which 61 had already occurred.

Repair of the anticipated 31 future leaks is expected to cost about $75,000 which will be distributed over the next 20 years. Based on experience with ten experimental rectifier units, the cost of a completely installed cathodic protection unit is $120 per well. It would be necessary to install 1280 of these units at a total cost of $154,000 in order to prevent leaks. Therefore, cathodic protection of the Loudon casings would not be attractive even if the cost per unit were reduced by one-half. Besides, it is not certain that cathodic protection would eliminate all future leaks.

It is believed that five magnesium anodes installed at each of the 1280 wells would supply enough current to lower the casing potentials to about —1.0 volt with respect to saturated calomel. Such magnesium installations cost an average of $75 per well or a total of $96,000 for the entire field, so this method of protection also is obviously not economical, even if it is assumed that the magnesium anodes would prevent all leaks.

The casings were originaly partially protecting the surface lines, so an increased corrosion rate for surface lines was anticipated following insulation. Experience during the past three years now permits an evaluation of this factor. It is estimated that an accumulated average of three leaks per mile has occurred as of January 1, 1950, on a total of 475 miles of surface lines, or about 1425 leaks. The repair of these leaks has cost an estimated $67,200. The annual cost of surface line leaks will no doubt continue to increase unless some effective measures are undertaken to control them. Investigations are under way to determine if the leaks are more or less restricted to parts of the system, and whether they are related to the flow of surface galvanic currents and pipe potentials. When these questions are answered, the most effective and economical control methods will probably become apparent.

Conclusions

Casing leaks in the Loudon pool are caused principally by the galvanic couple existing between the casings and surface pipe lines. The rate of occurrence of these leaks has been reduced about 90 percent by insulating the casings from the flow lines, which will result in an ultimate saving in casing repair expense of approximately $1,700,000 on 1280 Chester sand wells in the Loudon pool.

It is estimated that 31 additional casing leaks will occur during the next 20 years using insulation, and that these leaks could be prevented by the installation of cathodic protection at all wells. However, the cost of supplying cathodic protection with either magnesium anodes or rectifiers would be greater than the cost of repairing future leaks.

As expected, casing insulation has increased the rate of corrosion of surface pipe lines. Rough estimates of repair costs over the past three years indicate that effective methods are needed for reducing corrosion costs on the surface lines.

ACKNOWLEDGMENT

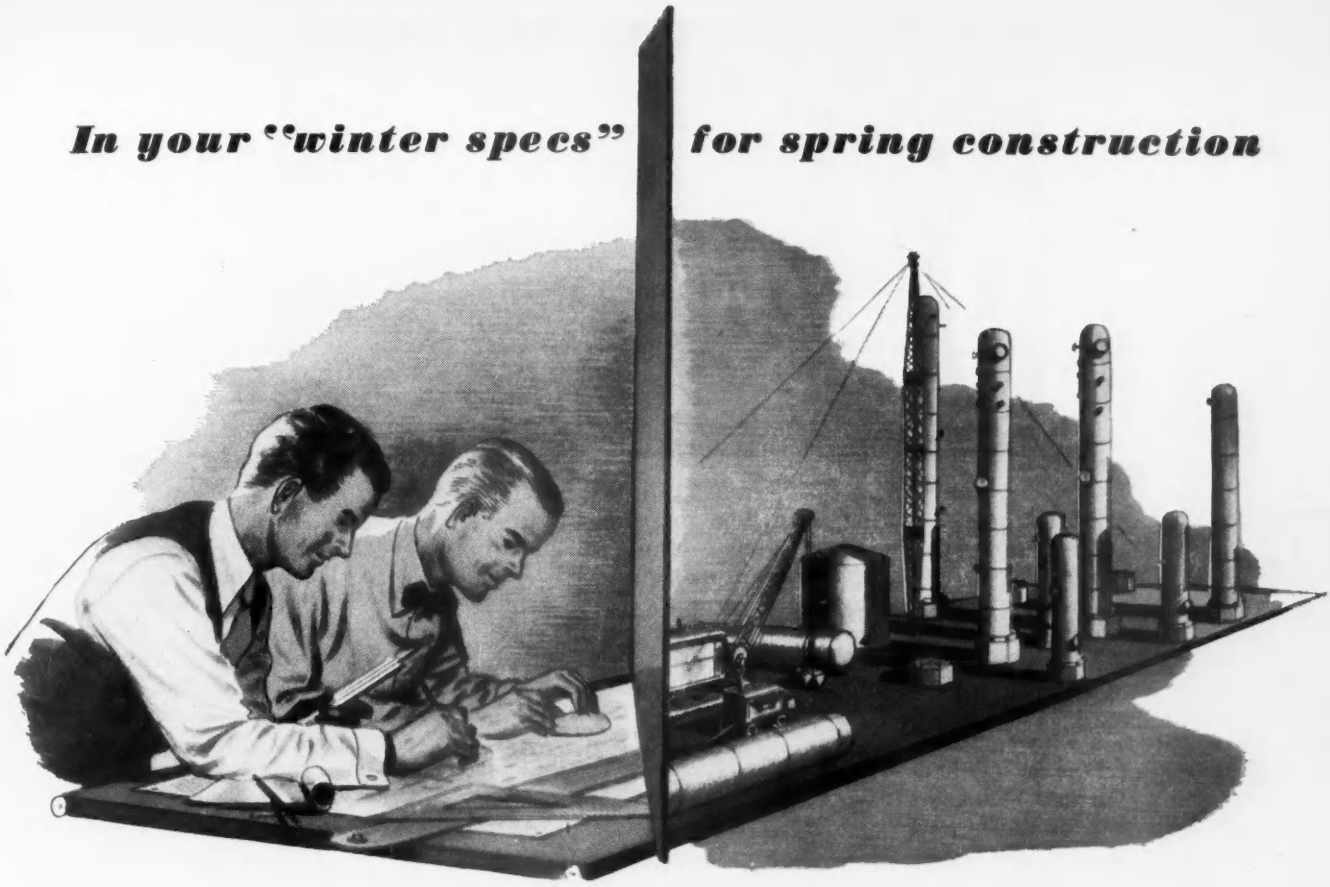
The authors wish to express their appreciation to the Loudon pool field engineers who obtained the data on which the report is based, and to the management of The Carter Oil Company for permission to publish the report.

REFERENCES

[1] Ewing, S. P., and Bayhi, J. F., "Cathodic Protection of Casings in the Loudon Pool." Corrosion, Vol. 4, No. 6, pp. 264-286 (June) 1948.

[2] Logan, K. H., Ewing, S. P., and Dennison, I. A., "Soil Corrosion Testing." ASTM Symposium on Corrosion Testing Procedures, 1937.

In your "winter specs" for spring construction



It will pay you to consider these four advantages of a Fluor Pulsation Dampening Piping System . . .

1 **Pressure drop calculation based on smoother flow**

2 **Improved gas metering accuracy**

3 **Virtual elimination of piping maintenance**

4 **Consideration of safety records**

The Fluor Pulsation Dampening Piping System is the newest and most practical approach to "pulse-free" piping yet developed. Designed primarily for installation in new construction utilizing piping to handle air, steam, or hydrocarbons at operating pressures ranging from a vacuum to 5,000 psi at any temperature, this Fluor-designed piping system removes objectionable pulse peak pressures caused by the reciprocating action of compressors.

Fluor Pulsation Dampening Piping Systems are *guaranteed* to provide a virtually smooth gas flow with minimum pressure drop. Safety is increased by eliminating vibrational stress on piping, heat exchangers and vessels. Compressor operating efficiency is increased, metering inaccuracies caused by pulsative flow are reduced, and maintenance problems common to conventional piping systems are cut to a minimum.

If you are in the process of drawing up specifications for current or contemplated construction involving compressor piping, it will pay you to write for Fluor Bulletin No, PDS-8501. Or, contact your nearest Fluor Representative for attention to your particular problem.

FLUOR "PACKAGE-TYPE" PULSATION DAMPENERS

Fluor offers two "Package-Type" Pulsation Dampeners for installation in already existing piping systems. The first, a Fundamental Pulsation Dampener alleviates objectionable pulse frequencies contributing to vibration and pulsation of compressor piping. The second, a Higher Frequency Pulsation Dampener, removes the offending pulse frequencies in the higher range and is competitive in cost with muffler or snubber-type devices.

FLUOR

Fluor Pulsation Dampeners and Pulsation Dampening Piping Systems are protected by U. S. and foreign patents issued and pending.

BE SURE WITH FLUOR

DESIGNERS AND CONSTRUCTORS of Refining, Natural Gas and Chemical Processing Plants.
MANUFACTURERS of Pulsation Dampeners, Mufflers, Gas Cleaners, Cooling Towers and Fin-Fan Units.

THE FLUOR CORPORATION, LTD., 2500 S. Atlantic Blvd., Los Angeles 22, Calif. Offices in principal cities in the U.S.A.
REPRESENTED IN THE STERLING AREAS BY: Head Wrightson Processes Ltd., Teesdale House, Baltic St., London, E.C.I., England

Elements of Dynamometer Tests

By
DAVID S. STEAR

DYNAMOMETER tests are made to achieve three primary objectives:[1,2,3,4,5]

● To obtain information to be used as a basis for the selection of pumping equipment. The design calculations for a pumping installation can be checked against dynamometer cards taken on a well with comparable conditions, since the selection of equipment is a problem of rating the well rather than the equipment and this is dependent upon the load, torque and horsepower requirements.

● To check well conditions after installation of the equipment to prevent trouble and improve the present operating conditions. When used in this manner, the dynamometer seems to offer a method far better than that of trial and error for determining the most satisfactory adjustments of the variables—pumping speed, stroke length and pump size.

● To test troublesome wells to reduce or eliminate the causes. Classed as troublesome wells are those which over a period of time show a high number of rod breaks and pump replacements due to such conditions as improper counterbalancing, overtravel or undertravel of the pump plunger and "pounding," all of which can be detected on the dynamometer card by the engineer and fieldman who understand how to interpret it.

Most well studies are trouble-shooting affairs, though it would seem the first two objectives should be emphasized since it is usually far cheaper to prevent trouble than to reduce or eliminate it once it has occurred.

Three main types of dynamometers are in general use:

1. The hydraulic type.
2. The mechanical type.
3. The electrical type.

The hydraulic-type dynamometer consists of two separate units, a pressure-transforming unit and a recording unit. The pressure-transforming unit contains a liquid which is compressed in proportion to the applied load. The pressure applied by the load is transmitted by the liquid to the recording unit where a record of the loads for the pumping cycle is charted.

The mechanical-type dynamometer depends on a strain gauge, attached to the polished rod, which records the load changes occurring in the rod. The loads are indicated by measuring the stretch over a short length of the polished rod. This stretch, which is proportional to the loads imposed on the polished rod, is magnified by a mechanical linkage and is recorded on a chart.

The third type is an electrical dynamometer consisting of a magnetic strain gauge and a recorder. This instrument uses suitable devices to measure a self-generated current which flows in amounts proportional to the load in the polished rod. The measured deflections are recorded on a photographic film.

At present a promising dynamometer[6] is a mechanical instrument using a specially calibrated steel ring which deflects in exact proportion to the load imposed across it. In its favor, it can be said that it is accurate; it is portable, weighing only 22 pounds; it is easy to install and is simple. Minimum adjustments are needed to keep it recording accurately.

The usual point for installing the dynamometer is on top of the existing polished-rod clamp with another clamp used above the instrument. In some cases, however, it may be attached under the existing clamp and the rod hangers lowered to provide space for the instrument. Occasionally it becomes necessary to use a polished-rod extension in order to attach the dynamometer.

A dynamometer card is a graph whose every point represents the resultant of the loads imposed on the polished rod. This load diagram is recorded with the stroke length for the abscissa and the corresponding load for the ordinate. Certain facts can be read quite easily or calculated from the card, but there seems to be no substitute for considerable experience to utilize the card fully and to be able to recognize all the information the shape of the card conveys. Many variables influence the shape of the card. A mathematical approach to the proper interpretation of dynamometer cards should include such factors as: rod weight, fluid weight, rod load, dynamic load, friction and fluid level. Fluid elasticity and rod columns modify load transfer rates and the time lag in transmitting the motion influences the load's displacement relation. Forced vibrations set up in the rod string further complicate the problem.[7]

An interpretation of a dynamometer card from the standpoint of the loads recorded as given by Marsh and Watts[8] is shown in Figure 1.

Considering this card, the loads would be as follows:

Maximum load $= C \times D_1$
Minimum load $= C \times D_2$
Range of loads $= C \times (D_1 - D_2)$
Average upstroke load $= C \times (A_1 + A_2)/L$
Average downstroke load $= C \times A_1/L$

Where:

C = calibration constant, pounds per inch of height of card
D = Maximum deflection, inches
D = Minimum deflection, inches
A = Lower area, square inches
A = Upper area, square inches
L = Length of card, inches

In addition to their direct measurement by a dynamometer, well loads of sucker-rod pumping installations may be calculated by any one of several formulas in common use. The final proof of the value of any formula of this type is the agreement of its results with those found by direct measurement. Much data has been presented to support the accuracy of

This article was prepared for WORLD OIL from a discussion at a joint meeting of the Mid-Continent, Oklahoma City and Kansas sections of AIME at the University of Tulsa.

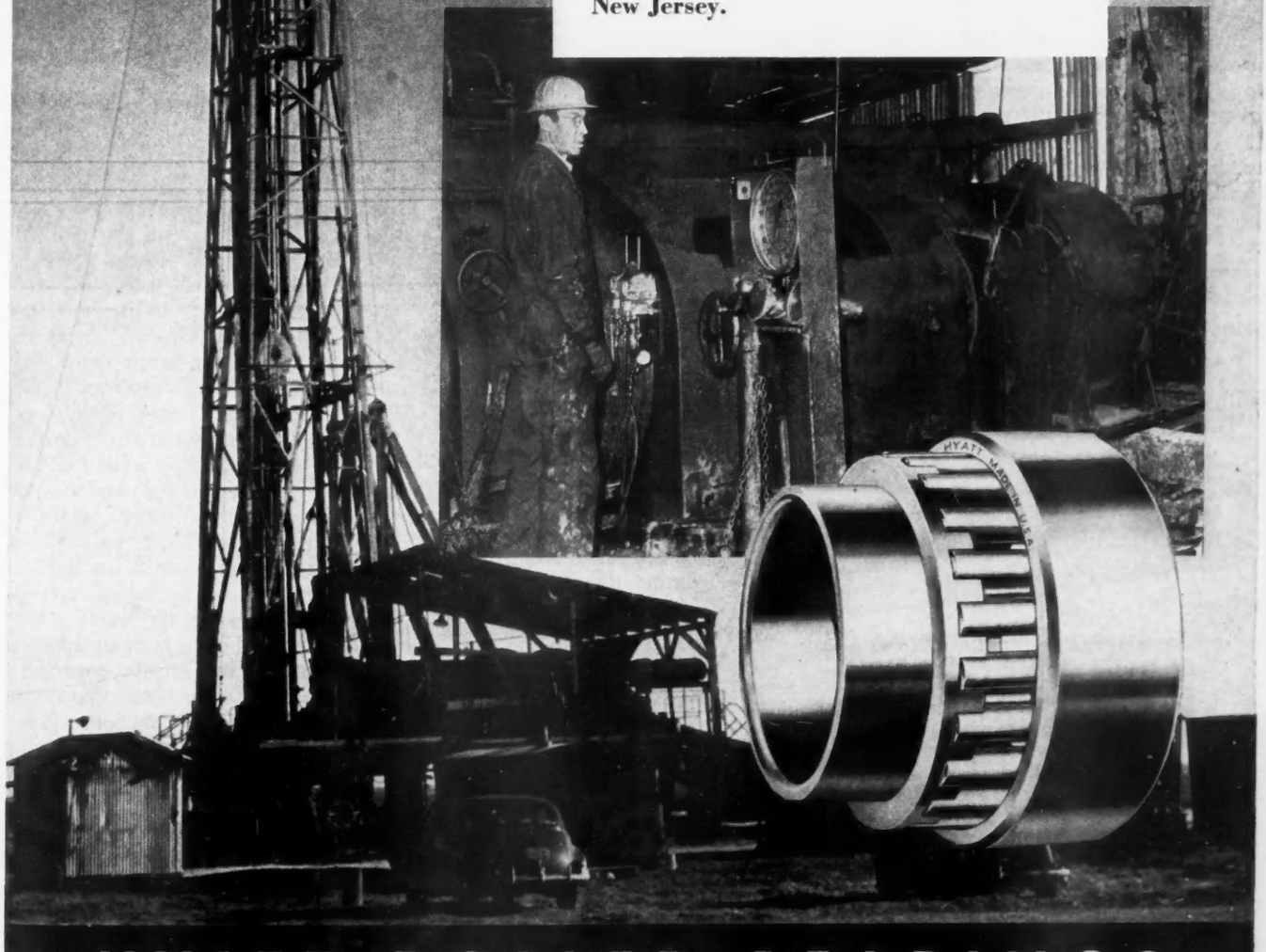
For Emsco—It's Dependable HYATTS

Dependable—the word that best describes the Hyatt Roller Bearings used in the equipment built by Emsco Derrick and Equipment Company.

All three sizes of Emsco Steam Drawworks are equipped with Hyatt Inch Series Bearings on each end of all three shafts.

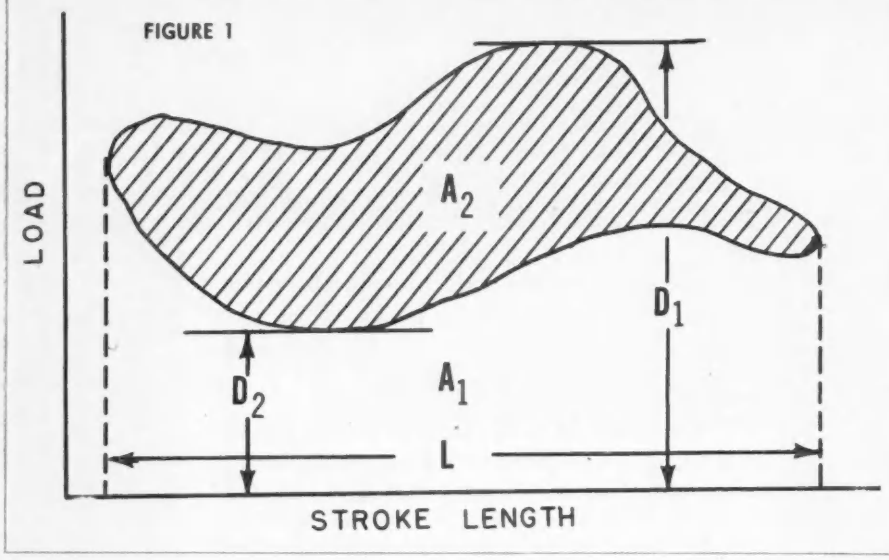
Emsco, like so many leading builders of oil field equipment, looks to Hyatt to fulfill its bearing requirements.

You can be assured that Hyatt Roller Bearings are the best bearing buy for equipment builder and user alike because they have proved their dependability through the years. Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.



HYATT ROLLER BEARINGS

FIGURE 1



these well-load formulas. It seems reasonable, however, to believe that no single formula can be devised to cover all possible well conditions. Probably if such a formula were devised it would be too complicated for everyday use. It is a question of simplicity or accuracy. To achieve simplicity certain factors, considered less important in their effect on well loads, have been disregarded so that the formula in its final form is only an approximation. The important thing to be considered, however, is the magnitude of the values obtained by calculations using the formula. Loads calculated by the formula should be higher than those actually occurring for the formula to have any use whatsoever.

The formulas for calculating well-loads are expressed as follows:

Slonneger (API) Formula

$$W_{max} = (W_f + W_r)\ (1 + LN/5400) \quad (1)$$

Mills Formula[9]

$$W_{max} = W_o + W_r\ (1 + LN^2/70500) \quad (2)$$

Langer Formula[10]

$$W_{max} = W_r - W_{rb} + W_f + (0.75)\ (LN)\ (17\ A_r \tan 0.0004\ DN) + A \quad (3)$$

Caraway Formula[11]

$$W_{max} = (W_o + W_r)\ (1 + LN^2/70500) \quad (4)$$

Where:

W_{max} = Maximum well load, pounds
W_f = Weight of fluid on the gross plunger area, pounds
W_o = Weight of fluid on the net plunger area, pounds
W_r = Weight of rods in air, pounds
W_{rb} = Weight of fluid displaced by full length of rod string (buoyant force), pounds
L = Length of polished-rod stroke, inches
N = Pumping speed, strokes per minute
D = Length of rod string, feet
A = Net plunger area, square inches
A_r = Area of sucker rod, square inches

Since its derivation in 1938, the Slonneger formula has carried the recommendation of the American Petroleum Institute. For a period of years afterwards considerable debate took place at its regular meetings to decide whether this recommendation should continue. In 1943 the entire matter was dropped from the agenda. The reason for discontinuing this discussion seems to have been that all the formulas were only approximate and misunderstanding had existed regarding their proper application.

At this same meeting Mills[12] presented a report on the accuracies of the three formulas then in question. (The Caraway formula had not yet been advanced.) Mills had taken the dynamometer cards from a group of wells tested and studied by Hosford and Kemler[13] some years before, and compared their measured values with the values calculated by the three formulas. These wells gave a wide range of operating conditions, but wells which were especially troublesome were not used in the analysis. Water was assumed the fluid in each case and the fluid level as given in the paper by Hosford and Kemler was used to determine the weight of the fluid. The over-all results of the relative accuracies of the three well-load formulas when checked against the maximum well load are given in Table 1.

The Mills formula proved itself superior to the other two formulas by giving accuracies of 90 percent or better in 40 percent of the tests, 80 percent or better in 74 percent of the tests, 50 percent or better in all cases and in no case a value off more than 50 percent. The Slonneger formula gave values with 90 percent accuracy in 24 percent of the tests, accuracies of 80 percent or better in 48 percent of the tests, 50 percent or better in 86 percent of the tests and finally less than 50 percent in 14 percent of the tests. The Langer formula showed still greater deviation. In only 5 percent of the tests was its accuracy more than 90 percent while in 52 percent of the tests its accuracy was less than 50 percent. The accuracy of the formulas was also checked against the measured maximum well load at mid-stroke. The results were comparable for the Mills and Slonneger formulas while the Langer formula was in considerable error. These two points for the check were chosen because the maximum well load determines the beam load capacity of the pumping machine required for a given well and the maximum well load at mid-stroke is one of the two factors which determine the torque imposed on the speed reducer. (The minimum well load at mid-stroke is the other factor influencing torque.)

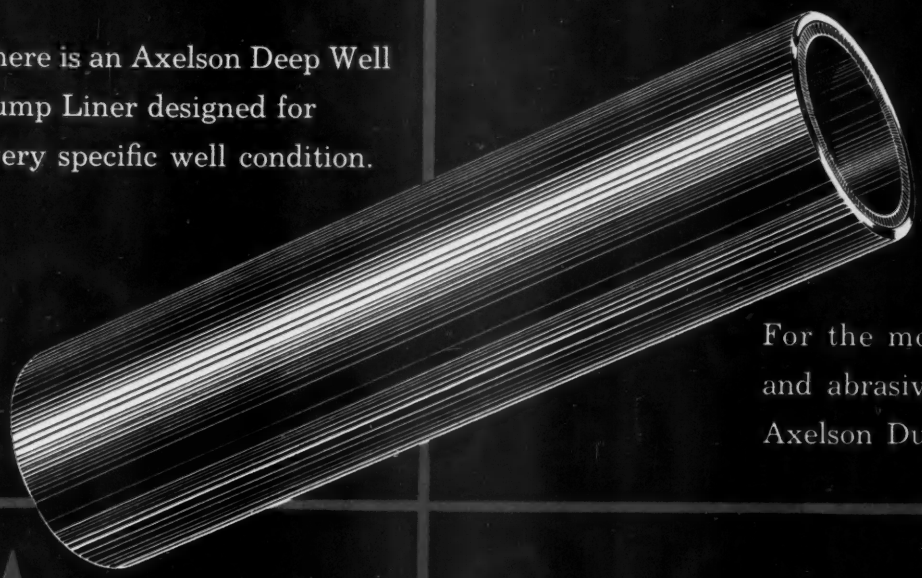
Table 1

Percent of Well Loads in Each Range of Accuracy for All Depths of Wells

FORMULA	0 to10 Percent Error	10 to 20 Percent Error	20 to 50 Percent Error	More Than 50 Percent Error
Mills.....	40	34	26	0
Slonneger...	24	24	38	14
Langer.....	5	7	36	52

An interesting paper on the correlation of calculated values with actual values is that of Langer and Lamberger[10] describing their findings on the subject. These researchers checked the three formulas (this was still before the Caraway formula) with actual field data of their own, obtained on an old well in the Oklahoma City field. The well was described as an abandoned dead well, straight, and having a constant casing fluid level of salt water with just a trace of oil. Equipment for recording values was elaborate and included testing instruments for surface and subsurface loads and speeds, as well as lengths of stroke. These values were taken at as many points on the surface as could be arranged conveniently. By varying the factors over which they had some control they succeeded in obtaining data covering a wide range. From these data they reached certain conclusions. Their tests seemed to prove that the actual values were equal or higher than the calculated values at high speeds but lower than the calculated values for low speeds for all the formulas. This they explained by the fact that the formulas all assumed the fluid load applied at once rather than gradually as is the actual case. They also concluded that the formulas of Mills and

There is an Axelson Deep Well Pump Liner designed for every specific well condition.



THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

For the most severe corrosive and abrasive conditions, specify Axelson Duax Liners.

AXELSON
First Choice

ASK AN AXELSON EXPERT

AXELSON MANUFACTURING CO. • PLANTS — Los Angeles 58; St. Louis 16 • OFFICES — New York City 7; Tulsa 1; Buenos Aires, Argentina; Caracas, Venezuela • DISTRIBUTORS — Jones & Laughlin Supply Co.; Great Northern Tool & Supply Co.; Industrial Agencies, Ltd., San Fernando, Trinidad, B.W.I.; Industrias Waldrip & Campbell, Barcelona and Maracaibo, Venezuela; Dominion Oil Field Supply Co., Ltd., Calgary, Canada; South American Supply Co., Avenida Tacna 592, Lima, Peru.

CHECK THROUGH WITH *Enardo*

SLIP-ON-FITTINGS

CLOCK SHUT-OFF-VALVE

VAPOR CONTROL

CLOCK SWITCHES

VAPOR CONTROL SYSTEMS

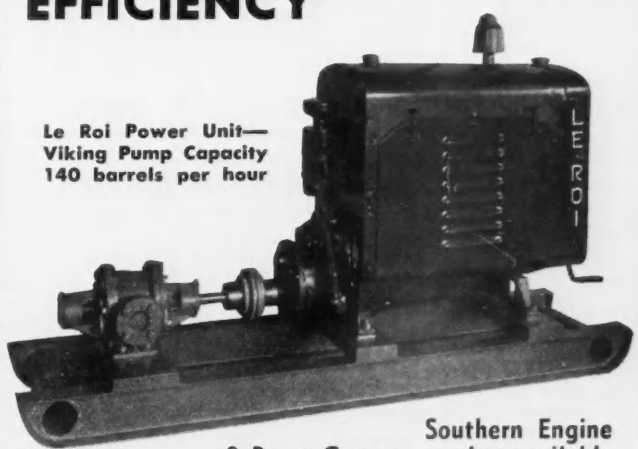
To conserve valuable vapors and keep out excessive air in your lease storage tanks write for information on the Enardo Vapor Control System. Consisting of an equalizer line . . . an automatic by-pass check valve on each tank and a diaphragm type in-line vent valve this system, in many cases, has paid for itself in 60 days. The equipment is so arranged that when the hatch on one tank is opened, that tank is automatically isolated from the rest, preventing vapor losses from other tanks.

ENARDO

BOX 1647
TULSA, OKLA.

THE RIGHT TEAM FOR EFFICIENCY

Le Roi Power Unit—
Viking Pump Capacity
140 barrels per hour



Southern Engine & Pump Company makes available to you 40 years of "KNOW HOW" in your pumping requirements.

• Complete units and replacement parts at all branches.

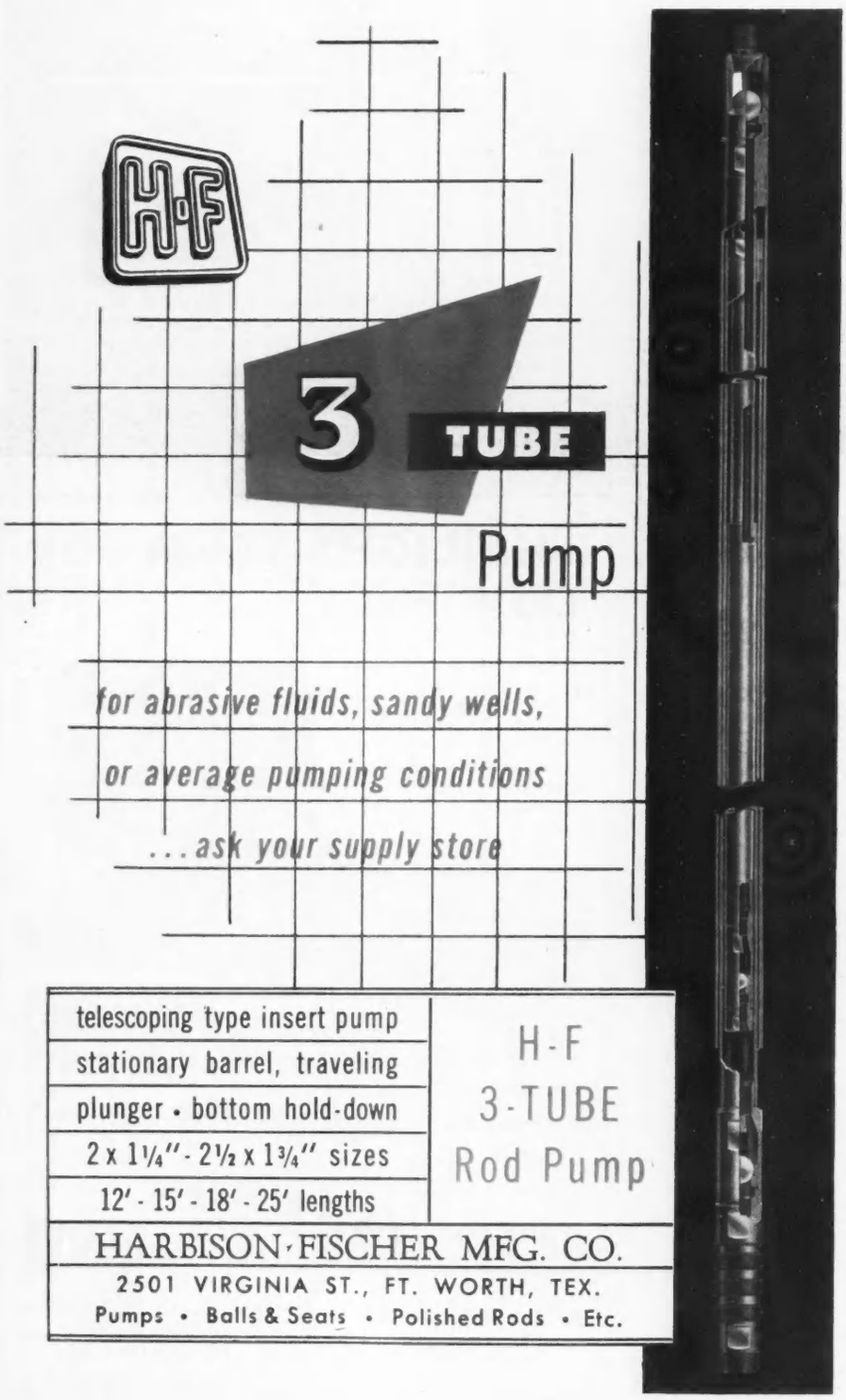
SOUTHERN
ENGINE & PUMP COMPANY

MANUFACTURERS • MACHINERY FACTORS • CONTRACTORS
Houston - Dallas - Kilgore - San Antonio - Edinburg
Corpus Christi, Texas • Houma and Lafayette, La.

Slonneger did not predict an increase with load and speed as great as they found. In the tests their formula seemed more closely to approximate the actual values than either of the other two. Objections have been raised to these tests because they considered only one well and one given depth.

More recently Caraway[11] wrote an article presenting another formula and new ideas on the subject of well loads based on his experience with pumping units. He concludes that the Slonneger formula is good for pumping speeds below 20 strokes per minute and of little value above this speed. The Mills formula, he states, is good for the same range but up to 25 strokes per minute due to its higher impulse factor. For pumping speeds above 25 strokes per minute he presents a formula of his own, which appears to be an improvement on the Mills formula. This formula is presented elsewhere in this paper. In actual comparisons with measured well loads of wells in the East Texas field the results shown in Table 2 were found. These well loads were checked at varied pumping speeds and tabulated on that basis. Here it is noted that the Slonneger formula gave values within 18 percent of the actual load; the Mills formula gave values within 10 percent of the actual loads; and the Caraway formula gave values within 8 percent of the actual load. It should be noted here that most of the values for the Slonneger and Mills formulas were on the low side while the Caraway formula gave values somewhat on the high side. The actual form of the Caraway formula differs but slightly from the Mills formula. It seems quite probable that the Caraway formula will have some application to the rather extreme conditions which he describes.

In conclusion, it can be said that the most satisfactory determination of well loads is through direct measurement with a dynamometer. Some cases will arise, however, where the load must be calculated by one of the four well-load formulas rather than from a representative dynamometer card, in which case some sort of safety factor should be applied to the calculated value to bring it into closer agreement with the actual. This safety factor should in all cases be based on previous experience with pumping installations.



REFERENCES

[1] Fagg, L. W., "Dynamometer Charts and Well Weighing." *Oil & Gas Journal*, January 12, 1950.

[2] Fagg, L. W., "Lower Lifting Costs Through roper Pumping Equipment Application." WORLD OIL, November, 1947.

[3] Johnson, D. O., "Taking the Pulse of a Pumping Well." *The Oil Weekly*, March 25, 1940.

[4] Zaba, J., "Oil Well Pumping Methods." *Oil & Gas Journal*, 1943. A series of articles.

[5] Walker, A. W., "Use of Dynamometer in Oil Production Work." *Petroleum Engineer*, August, September, 1931.

[6] Johnson, D. O., "Ring Dynamometer for Pumping Wells." WORLD OIL, November, 1948.

[7] Slonneger, J. C., "Vibration Problems in Oil Wells." API Drilling and Production Practice, 1937.

[8] Marsh, H. N. and Watts, E. V., "Practical Dynamometer Tests." API Drilling and Production Practice, 1938.

[9] Mills, K. N., "Factors Influencing Well Loads Combined in a New Formula." *Petroleum Engineer*, April, 1939.

[10] Langer, B. F. and Lamberger, E. H., "Calculation of Load and Stroke in Oil-Well Pumping Rods." *Oil & Gas Journal*, May 7, 1942, July 2, 1942, July 9, 1942.

[11] Caraway, A. E., "How to Calculate Well Loads and Select Pumps." *Petroleum Engineer*, June, 1948.

[12] American Petroleum Institute, "Production Bulletin 230," 1943.

[13] Hosford, E. and Kemler, E., "Typical Dynamometer Cards and Their Application." API Drilling and Production Practice 1939.

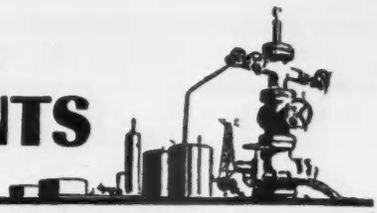
Table 2

Peak Polished-Rod Loads, Measured and Calculated at Varied Speeds

Strokes Per Minute	Measured Polished-Rod Load (Pounds)	CALCULATED (Pounds) Slonneger	Mills	Caraway
16	6290	6450	6220	....
18	6630	6550	6380	....
20	7120	6670	6560	7250
24	7800	6900	7040	8000
29	8430	7180	7700	9100
Average Percent Difference	....	−17.5	−9.5	+7.4

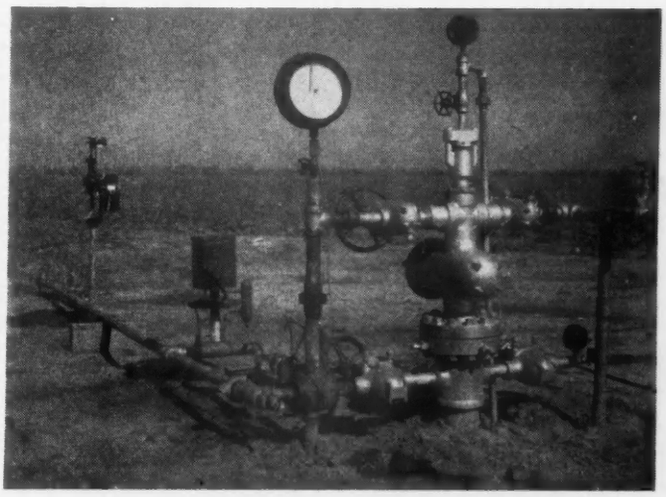
How to do it!

PRODUCTION HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas

HOW TO—Prevent Freezing in Gas Flow Line Chokes

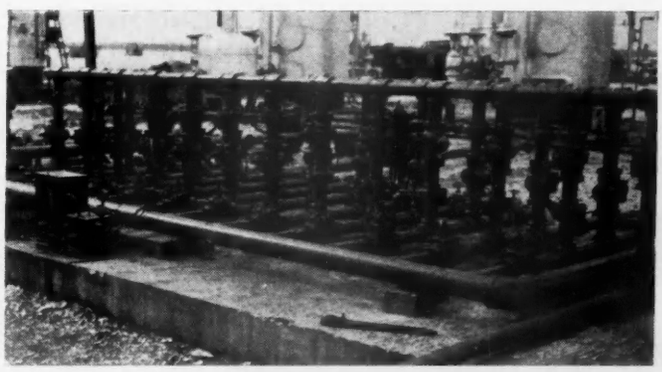


The pressure drop resulting from a slight amount of moisture entrained in gas produced under relatively high pressure with the flow restricted by an orifice, will, under certain conditions, cause ice to form, thereby clogging up the orifice or flow line. If the case is not too severe, the problem may be solved by heating the point in the stream where the pressure drop occurs.

Where gas is produced from the casing, and oil with water is produced from the tubing, a simple way to heat the gas regulating choke to prevent freezing up is to place a jacket around the choke and flow the tubing through the jacket. In the illustration, a dually-completed well produces approximately 90 percent water through the tubing. Gas, produced through the casing annulus, is used for gas-lifting the tubing. The regulator used to reduce the pressure is placed beneath the tee on the left wing of the Christmas tree, and equipped with a jacket so that an annulus exists around the choke. Flow from the tubing passes through this jacket and transmits some heat to the flowing gas stream inside the choke. Oil and water is then flowed to treaters for further handling.

Gas is taken off the gas line by an intermitter which injects the gas down a macaroni string to lift the liquid inside the tubing. The orifice meter on the gas line measures gas to another lease. A recording pressure gauge periodically records tubing pressures in order to determine the efficiency of the gas lift. This device has been in operation in sub-freezing weather and has prevented any trouble due to hydrates forming in the gas line.

HOW TO—Introduce Emulsion Chemical at Manifold



Considerable savings can be made in injecting emulsion chemicals into well fluids that require relatively small amounts of treating liquids, by providing for injection at the flow line manifold as illustrated. Oil with some water flows from the wells into this manifold shown resting on two wooden blocks lying on the concrete pad. The vertical risers connecting to an elevated manifold are for testing purposes.

The four-inch header shown here is connected into a heater-treater, and fluid flowing into it is treated with an emulsion-breaking chemical which speeds up the separating action and reduces the amount of heat to effect adequate separation of oil from water.

Since some wells may be shut in for either proration reasons or for work overs, a chemical injection tap into the header was made near its midpoint to evenly distribute the chemical throughout the flow stream. This tap was made by welding a 1½-inch collar to the header and attaching a globe-type valve with reducing fittings so that a copper tube could be used to carry the chemicals from the feeder in to the flow of fluid. The direction of fluid flow through the header is toward the right, but sufficient chemical is entrained into the stream to provide satisfactory emulsion breaking in the heater-treaters.

Such an injecting system reduces substantially the installation expense on each well, and also aids the pumper in maintaining the injecting program. Gas required to power the chemical injection pump is supplied from the separators which exhaust into the field gas system.

HOW TO—Loosen Sucker Rods on Wet Pulling Jobs

When the pump is stuck or sanded up in the bottom of the tubing in a rod-equipped well, it is necessary to pull both simultaneously. Usually, the tubing joints will not coincide with the rod joints, and a modification in the normal pulling procedure must be made. There is little difficulty in breaking the tubing joints, since they are exposed as the pipe is lifted from the well. However, if the rod joints are between the ends of a tubing joint, they cannot be reached and must be broken by manipulating the exposed end of the rod. When the rods are made up tight, this operation is difficult and may result in damage to the rods by undue torque.

The procedure followed by one company to "bulldog" the problem makes it necessary for one man to go up in the gin pole. When the tubing is supported by the spiders on the wellhead, and part of a joint extends out of the open end, the following method is used. The rods are rotated to the left by a pipe wrench until the entire string is twisted and in tension. The rods are engaged by the elevators but left slack. The box end of the rod coupling is covered with a male cap. The man in the gin pole uses a sledge hammer to deliver a sharp blow to the entire rod string. This sudden jar breaks a coupling at some joint below the surface, and the upper section can then be unscrewed. Rods in the free section can be removed in the conventional manner, and when taken from the well, the tubing can again be pulled as usual.

This method merely requires a changeover from tubing elevators to rod elevators. By using this method, it is not necessary to put sufficient twist in the rod string to damage the rods, yet they can be loosened and considerable time saved in the complete pulling job.

BORASCU* destroys weeds and grasses at a fractional cost of most methods such as hoeing, etc. You can enjoy substantial savings by using BORASCU* about *your* tank batteries, well sites, heater units, and rod lines, just as many other petroleum producers are now doing, for BORASCU* does destroy most vegetation and prevents future growth for 12 to 24 months, or longer, when correctly used! Borascu* and Concentrated Borascu are applied dry . . . if spray equipment is to be used, we suggest our new, improved Polybor-Chlorate for it is readily soluble and safe to use. Yes, it is nonfire-hazardous although it combines the plant-destroying powers of borates and chlorate . . . gives quick knockdown of tall standing vegetation. See these chemicals demonstrated on your property under your conditions without any obligation. . . . act now!
*Reg. U.S. Pat. Off.

Write for Illustrated Service Bulletins !

BORASCU WEED KILLER

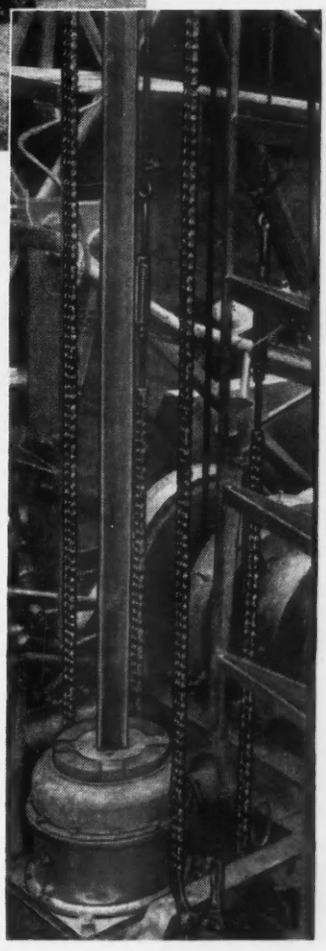
NONCORROSIVE*
NONPOISONOUS
NONFLAMMABLE
NONSELECTIVE
ECONOMICAL
*To Ferrous Metals

PACIFIC COAST BORAX CO.
DIVISION OF BORAX CONSOLIDATED LIMITED

Weed Control Dept. Representatives located in the following cities: CHICAGO • NEW YORK CITY SEATTLE • PORTLAND, ORE. • CLEVELAND, OHIO • AUBURN, ALA. • MANHATTAN, KANSAS HOUSTON, TEX. • FT. WORTH, TEX. • SIOUX CITY, IOWA • BOZEMAN, MONT. • MINNEAPOLIS SAN FRANCISCO • Home Office: 510 W. SIXTH STREET, LOS ANGELES 14, CALIFORNIA

TRADE MARK

DIAMOND Roller Chains Help Maintain High Output and Economy of Mayhew Drills



Close-up of portion of Diamond Roller Chains on pull down.

Where the new Canadian oil fields are amazing the world—Mayhew Drills (Diamond Chain equipped) are in the midst of activities.

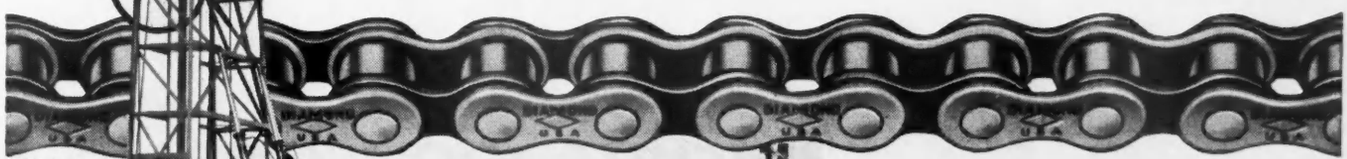
● In building up years of performance records, the long life dependability of the power drives used on Mayhews has been an essential factor.

Diamond Roller Chains again prove the value of their great reserve strength and uniform quality—link for link. They are used for the power take-off, pump, pull down, pull down drive and in the heart of the Mayhew Rig—the transfer case. Here a series of shafts are driven by Triple ¾" Pitch Roller Chain from which power is transmitted to the component units such as the rotary table and draw works.

Wherever there are oil field operations, you will find Diamond Roller Chains on leading makes of equipment and preferred by experienced oil country men.

DIAMOND CHAIN COMPANY, Inc.

Dept. 485, 402 Kentucky Ave., Indianapolis 7, Indiana
Tulsa Office: 2238 Terwilleger Blvd.

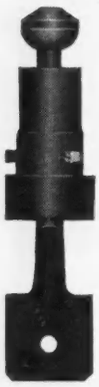


DIAMOND ROLLER CHAINS

Miller SAND PUMPS

In every major producing area where sand or sediment is a problem, you'll find Miller Sand Pumps and Bailers are standard . . . the leaders in clean-out equipment. For 26 years Miller has held this leadership, with continuous improvements and faithful service.

The Miller Sand Pump is made in regular and heavy duty types in sizes listed below. Lug type, chisel, sand and bailer bottoms are easily interchanged.



SAND PUMP and BAILER SIZES:

Outside Diameters

2½"
3"
3½"
4¼"
5"
5½"
7"

Lengths

20 feet
25 feet
30 feet

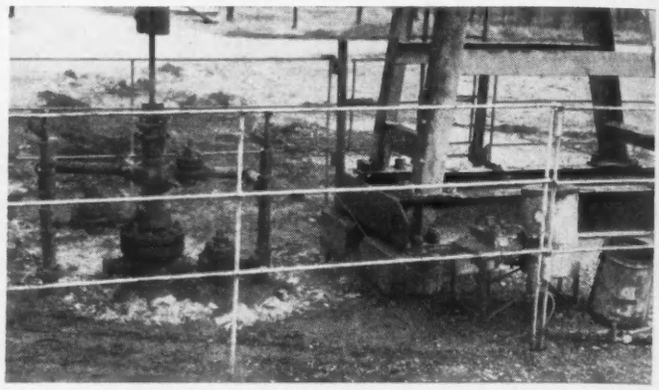
Special Sizes and Lengths Made to Order!

Write for new descriptive price list on Miller Sand Pumps and Bailers. See Composite Catalogue Page 3305 for details.

MILLER SAND PUMP CO.
1524 S. E. 29 St. . . . . Box 4516
OKLAHOMA CITY 9, OKLAHOMA

EXPORT OFFICE:
30 Rockefeller Plaza-New York 20, N.Y.

HOW TO—Add Corrosion Inhibitor



Anti-corrosive practices have been adequately developed to combat most cases of down-the-hole corrosion. Such practices usually employ some method of inhibitors which, in part at least, form a film over the metal surfaces in the tubing and casing. This method is normally carried out by injecting the inhibitor in the casing annulus and allowing it to flow to the bottom of the tubing where it reverses its flow back to the surface inside the tubing, thereby completely covering the affected areas.

However, it is not uncommon to encounter "problem" wells which defy routine treating methods, and special means must be devised to provide adequate protection against corrosion. Such a problem well is the one illustrated. This well produces from one low-pressure formation approximately 5000 feet deep. The tubing is not packed off and there is sometimes sufficient pressure to cause the well to flow naturally.

In order to produce the allowable for the well, a pump was installed, and the well permitted to produce from both the casing annulus and the tubing which was pumped. Such a condition posed a prob-

For Complete Protection, Use

HERCULES

TUBING HANGERS

Because of the protection provided, no well should be "put on the pump" without installing a Hercules Tubing Hanger for suspending the tubing. All Hercules Tubing Hangers use the well known Hercules overhead packing arrangement. Made in all sizes to support up to 4" tubing. There is also available a Hercules type RH Hanger with means for packing off around both cable and tubing when used with Reda bottom hole pumps. To assure complete tubing protection, be sure to specify Hercules Tubing Hangers. Write for Bulletin.

Sold at all Supply Stores

HERCULES TOOL COMPANY
Manufacturers of Oil Field Equipment

General Office and Plant:
17th and Phoenix
P. O. Box 286

TULSA, OKLAHOMA

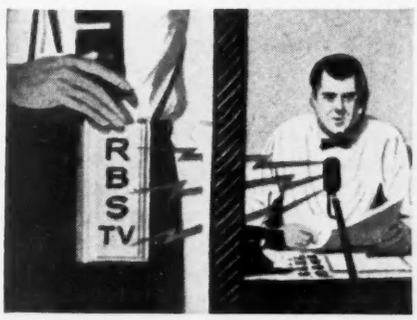
Telephone 3-1186
Cable Address
"HERTOCO"

California Representative:
L. T. (Ted) WALTIMIRE
Phone 4-4169 - P. O. Box 1612
Bakersfield, California

Export Representative:
OIL FIELD EQUIPMENT CO., INC.
T. E. WARD, President
30 Church St., New York 17, N. Y.

"Tell Her to Cheat a Little..."

1. **From a distant** television control room, the director asks the actress to "cheat a little". . . that is, turn more toward the camera while still giving the illusion of looking directly at the dagger. Silence is the strict rule and the director must communicate through the floor manager. This key man receives instructions over an ingenious "walkie-hearie."



2. **This tiny closed-circuit radio** enables the floor manager to hear and pass along directions to the cast. With this new wonder, scientists have solved a baffling communication problem. And scientists have also solved the problem of winter engine wear with new Conoco Super Motor Oil.

3. **50,000 Miles—No Wear!** After a 50,000-mile road test, *with proper drains and regular care*, engines lubricated with Conoco Super Motor Oil showed *no wear of any consequence* . . . in fact an average of less than 1/1000 inch on cylinders and crankshafts. Gasoline mileage for the last 5,000 miles of the test was actually 99.77% as good as for the first 5,000 miles!

Now in its 76th year, Continental Oil Company is still a leader in oil research and a pioneer in oil-perfecting additives, with more than 100 patents on discoveries that improve performance and lengthen the life of your car.

CONTINENTAL OIL COMPANY

lem in injecting inhibitors so that complete coverage would be made. Solution to this problem was to cause the well to "recirculate" its production for four hours out of each 24.

The flow line leading to the separator is closed, and the casing by-pass line opened. This line consists merely of a 2½-inch connection from the tubing outlet that connects into the casing flow line. A plug valve in the by-pass seals off the two outlets.

Chemical inhibitors are injected by means of a chemical feeder that discharges into the vertical riser seen at the right of the casing head. When the pumper opens the by-pass valve and closes the flow line valve to the battery, he starts the chemical pump. The desired amount of chemical is injected over the four-hour period, while the pumping unit continues to operate. The pressure put up by the pump overcomes the formation pressure and causes the fluid to circulate from the tubing into the casing and back into the tubing, thereby building up the protective film.

Produce wells with large water-oil volume longer—with JENSEN

Because of lower operating and maintenance costs, a Jensen unit can pump a well with large water-to-oil ratio longer than most units. This lower operating cost is achieved by design proved through years of field testing; quality gears and anti-friction bearings; and precision manufacture. More of the power of the prime mover is applied to the polish rod, thus lowering the cost of raising each barrel of fluid. There are few—if any—spare parts to buy and maintenance is held to a minimum.

Get the most out of your wells—keep them producing profitably. It's as easy as saying "Jensen" at your nearest dealer.

JENSEN

Bros. Mfg. Co., Coffeyville, Kan.

Export Office: 50 CHURCH STREET, NEW YORK CITY

HOW TO—

Make Portable Boom For Pickup Truck

A constant hazard encountered around oil fields is that of improperly lifting heavy material which results in wrenched backs, hernias and other injuries of a more or less serious nature. Here is a device designed to reduce many of the heavy lifting jobs in the field. Essentially, it is a portable boom and hoist which may be mounted on the rear end of a pickup truck.

The boom is shown supporting a drum of chemical weighing about 550 pounds. It consists of a vertical riser made of two-inch salvaged tubing, welded to provide a bracket at the top with an eye so the chain hoist may be attached. The bracket is braced and extends about 20 inches from the riser which itself is approximately seven feet high.

The boom fits into a base member made of 2½-inch tubing about 12 inches long. This base piece is firmly welded to the truck bed and rests on a plate supported by braces. The base was drilled and tapped so a ¾-inch bolt could be used to lock the boom in position for short hauls. Ordinarily, the boom is carried in the truck bed or stored in the warehouse.

In operation, the boom is set up in its base, and the load attached to the chain hoist. Only one man is required to hoist the load up to truck-bed height where it can be swung over the truck and lowered to the bed. The truck can be unloaded as easily. This simple hoist can be carried everywhere in the field where manual lifting is required, and has proved to be a back saver.

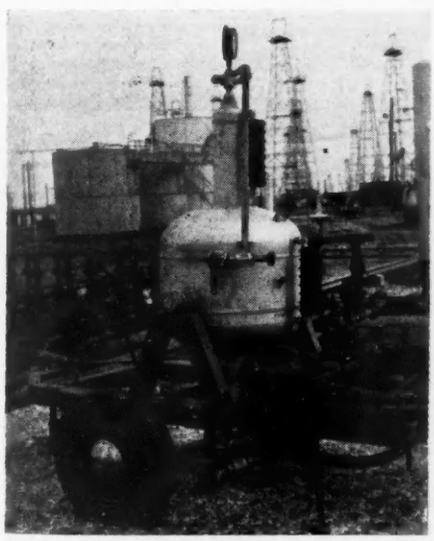
HOW TO—

Mount Liquid Meter Prover on Trailer

Where liquid meters are used to measure the production of oil, and where relatively large volumes are handled, it is a good practice to periodically check these meters for accuracy. One way to check such a meter is to flow through it and gather the fluid in a stock tank that has been strapped. However, this procedure may not be possible with many tank battery layouts or because a spare stock tank cannot be made available for testing purposes.

To provide such a check on liquid meters used in the measurement of oil produced from wells and from leases, a standard liquid meter prover was fabricated. It was constructed according to ASTM specifications with a liquid leg at bottom and at top. Fluid enters the bottom leg and the displaced gas is released out the top of the meter. Through these connections, gas pressure can be applied to force the contents of the prover into storage.

In order that one meter prover could be used for the entire field, it was mounted on a light-weight two-wheel trailer as shown. The prover is pivoted near its center, perhaps a few inches below the geometric center, on large A-frame supports. Pivoting is necessary to lay the prover in a horizontal position when traveling from one lease to another. A split-collar saddle fits around the upper neck so that the prover can be rotated 90 degrees and firmly anchored in this position. Adequate flexible hose conveys the fluid to and from the meter prover. The trailer frame can be stabilized in a vertical position by two adjustable stakes located just behind the meter prover vessel. These stakes simply slide up or down inside a split collar that can be clamped together with a bolt.



SPEEDS OIL TANK CONSTRUCTION WITH PIPER PLANE

To keep track of as many as 15 widely scattered erection crews, Lawrence N. Shupp, Assistant Field Superintendent of the Graver Tank and Manufacturing Company, owns and uses a fast four-passenger Piper plane.

"I just about live in my Piper," says Mr. Shupp. "I flew my first Piper over 42,000 miles in 11 months and now have over 22,000 miles on my new 4-passenger Piper.

"I definitely find it cheaper to fly than to drive, and furthermore I spend more time *on the job* rather than driving to it. The plane has also prevented lengthy delays by flying in repair parts for equipment."

A TYPICAL DAY'S TRIP

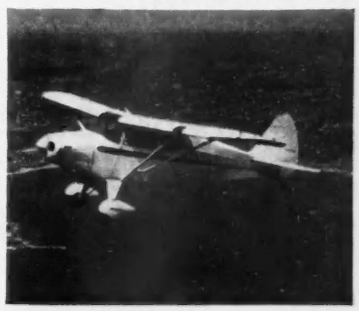
		MILES
6:30 a.m.	Left Allentown, Pa., for Camden, N. J., to leave part for diesel motor on near-by job.	65
8:15 a.m.	Arrived at Atlantic City to inspect erection site.	50
2:00 p.m.	Flew to Nantucket Island, Mass., to inspect erection job and leave 200 pounds of welding electrodes unavailable locally. (Trip by boat would have required 2 days.)	330
4:15 p.m.	Inspected erection job at Providence, R. I.	100
8:45 p.m.	Landed at Allentown.	235
	Total Miles	780

And Mr. Shupp says, "This trip wasn't unusual as I have covered a thousand miles in one day a number of times."

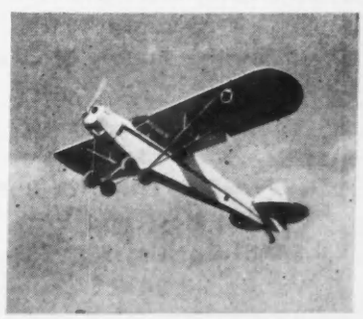
YOU, TOO, WILL PROFIT WITH A PIPER

There are hundreds of ways in which low cost, economical Piper planes can serve the oil industry—in production, construction, sales and service. Investigate now how a Piper will save you time and money. See how a Piper eliminates reservation and timetable worries. And now Piper dealers make it so easy to learn to fly, by teaching you while flying cross-country on business trips. Write for brochure on this new "Learn-as-you-travel" program.

TWO FINE PIPER PLANES FOR YOU



Piper, world's largest builder of personal planes, offers two ideal planes. The fast, easy-to-fly Piper Pacer (shown above) which carries 4 people at two-mile-a-minute speed for less than bus fare. And, the Piper Super Cub (below) is especially suited for oil field work. Takes off and lands in less than 150 feet! Carries two, or quarter ton of freight. Write for literature on these two remarkable planes, unmatched in price or performance by any other make.



PIPER AIRCRAFT CORP., LOCK HAVEN, PA.

"TRAVEL FASTER, CHEAPER BY PIPER"

ALL

Radiator Cooling Systems Can Be Free From Rust and Scale

EASILY
SAFELY
SURELY

Thanks to

SAND-BANUM SPECIAL
Concentrated Colloidal Tablets

•

And—for BOILERS
It's
SAND-BANUM
Pure Colloidal Concentrate

All Active Ingredients

Use Ounces Only Once a Week

•

Stocked by Leading Supply Houses

•

Write For Proof on Either or Both on How and Why SAND-BANUM SERVES AND SAVES

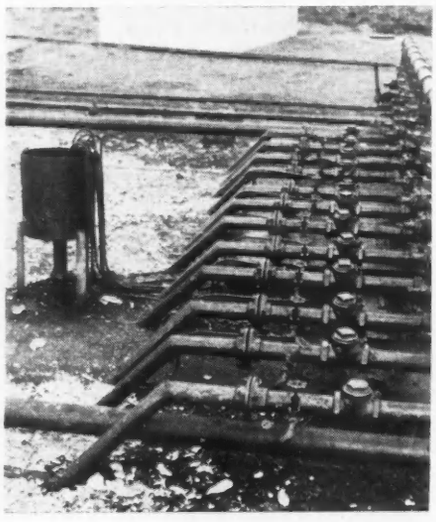
AMERICAN SAND-BANUM CO.
Established 1926
9 Rockefeller Plaza
New York 20, N.Y.

HOW TO—

Gather Test Samples At Flow Manifold

Periodic sampling of oil produced from each well is necessary to calculate oil and water production from each well and lease, and is also useful in serving as a guide in well production conditions. The job of testing each well can be greatly simplified and much time and duplication of equipment eliminated by seting up a sample gathering system at the flow line manifold.

The system illustrated has resulted in elimination of waste and standardization of installation, and saves many steps for the pumper or engineer making the shake-out test. Twelve flow lines converge at this tank



battery, and the line are shown equipped with flange connections, check valves and plug valves which tie into the manifold leading to heater-treaters.

Collars for ¾-inch pipe have been welded into each flow line between the flange and check valve. A short ¾-inch nipple connects the flow line to a small globe valve. An ell tied into the valve is fitted with a reducing bushing that connects into the ½-inch tubing leading to the sample gathering vessel, shown at left.

All ½-inch tubes leading from each flow line converge at the gathering vessel in a neat fashion, and are bent so that the discharge end of the tube is directed downward in the vessel. Made of 24-inch casing about 20 inches long, the vessel is supported on four legs and is equipped with a three-inch drain line which carries overflow fluid to a central gathering sump inside the fire walls.

When a sample is to be taken on a flowing well, the sample line valve is opened and the fluid permitted to flow for a few minutes to assure a true uncontaminated sample.

CHIEF PARAFFIN SOLVENT
(Patent Pending)

"Chief of All"
(Copyright 1947)

CHIEF Paraffin Solvent has already been proven by extensive use over a period of years. IT has been used successfully in Wyoming; Kansas; Michigan; Oklahoma; Louisiana; New Mexico; East, West and North Texas; and the Texas Panhandle.

CHIEF PARAFFIN SOLVENT IS ALWAYS GUARANTEED if used as directed.

Distributed By

GLOBE SALES CO.
704 VIRGINIA AVE. WICHITA FALLS, TEX.

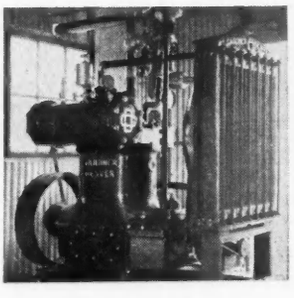
SECONDARY MODERN RECOVERY

TECHNICAL CONSULTING PRODUCTION ENGINEERING SERVICE, INCLUDING CORE ANALYSIS

PRESSURE MAINTENANCE WITH GAS OR WATER

REPRESSURING WITH GAS OR WATER

Electric Driven Repressuring Gas Compressor



Montague County, Texas

SURVEYS
ESTIMATES
DESIGN
INSTALLATION
SUPERVISION

PETROLEUM ENGINEERS
CABLE & STINE
WICHITA FALLS, TEXAS

Using a "kytoon"—a cross between a balloon and a kite—Southwestern Power Administration engineers are rigging a photoflood bulb before sending it aloft in making a line-of-sight survey at night. The technique is economical, eliminating much ground-crew survey time and is particularly adaptable for such surveys involving long distance points and rough terrain.

Novel *Sighting Method* Cuts Survey Time

By E. EUGENE HOWE
Chief, Systems Operations Branch, Southwestern Power Administration, Tulsa

FACED WITH the problem of making line-of-sight surveys between distant areas and in rough terrain, Southwestern Power Administration engineers developed a unique method which eliminated much field work and provided good results at a considerable saving of time and effort. Engineers also derived a formula which makes it easy to compute distances between high points without involved calculations. Method and formula are presented as being of interest to oil industry communications engineers.

SOUTHWESTERN Power Administration operates over a wide area and its communications requirements include remote supervisory control, relaying, telemetering, and load control for power equipment and circuits, in addition to voice requirements. Recently it was decided to make a base-mobile communication survey in connection with the installation of a microwave system. Because the survey involved long distances and rough terrain, it was decided to employ the method here described as it presented features which not only would save considerable time but also would eliminate the time-consuming functions of ground survey parties.

In order to minimize the amount of time expended in field work, certain preliminary office investigation was conducted. Using available contour maps, possible base station tower locations for the base-mobile system were selected, alternate microwave tracks were laid out between tower locations, and a profile of each track made in the office. Examination of these profiles more clearly indicated maximum line-of-sight distances and possible tower locations. These profiles, however, did not take into account the curvature of the earth. It is possible for such profiles to indicate perfect line-of-sight between two points, yet, when earth curvature is taken into account, it may be found that intervening high spots preclude line-of-sight between the two points in question. Administration engineers have applied conventional earth curvature equations to check field and office work.

Having determined from office investigation the most likely microwave line-of-sight tracks, the next step was to develop apparatus, practical for use in actual field tests, to secure data to determine the required height of a tower at a proposed location. Administration engineers developed a rig for this purpose. Two kytoons, a combination kite and balloon were harnessed together. The balloon is filled with helium gas and equipped with wings giving air-foil lifting action in

addition to the lifting action of the helium, depending on the available wind velocity. Lifting power of the kytoon is said to vary from 1 to 12 pounds for a wind velocity up to 50 miles per hour, but does not recommend its use in wind velocities greater than 25 mph.

The kytoon, which is held captive by a nylon cord, is unstable in gusty winds, ducking and bobbing in all directions. Experience bears this out in that a kytoon was lost on a particularly gusty day while making preliminary tests of lifting power. Due to greater visibility afforded, line-of-sight tests are run at night. A 250-watt, 115-volt, photoflood bulb was energized by a portable one kilowatt, 120-volt, gasoline-driven AC generator whose output voltage was stepped up by means of two 115-volt variacs in series to approximately 160 volts in order to overcome the resistance in the circuit consisting of a No. 21 enamel-covered, magnet wire and a No. 20 plastic-covered, copper wire. The plastic-covered wire was used as a safety precaution to secure greater insulation after it was found through tests that the kytoons would lift the insulated wire. This circuit was made approximately 500 feet long, marked at intervals of 20 feet with colored tape to determine the amount of circuit in the air and thus determine the height of the lamp. The circuit was terminated on an improvised plywood switchboard panel through a switch and fuse. The voltage drop in the circuit is large, but experience indicates that sufficient voltage is delivered at the lamp to provide adequate brilliancy.

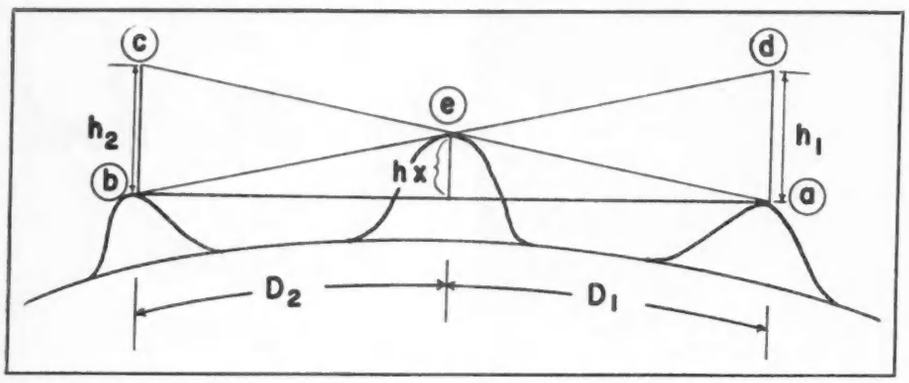


FIGURE 1

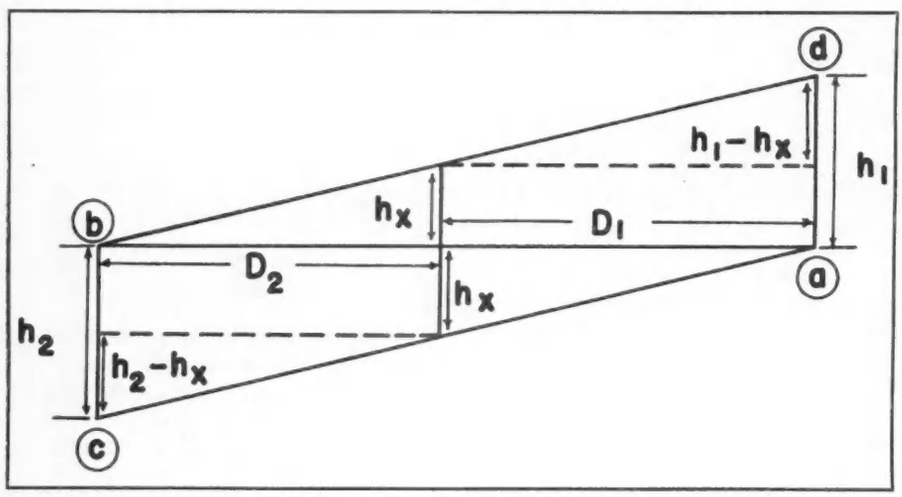


FIGURE 2

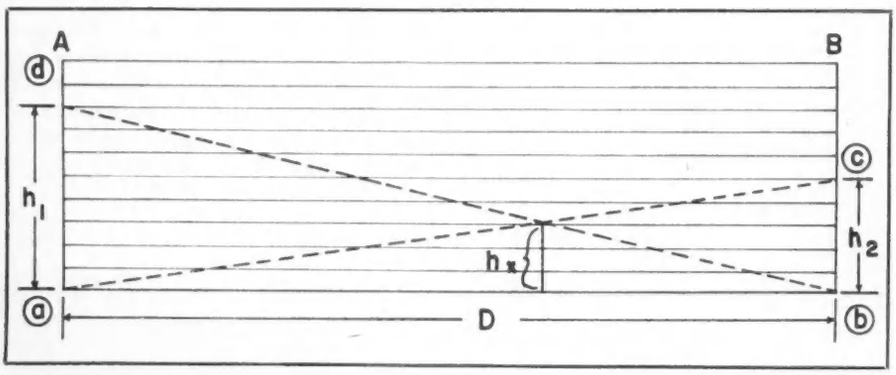


FIGURE 3

Heating of the wire is of no consequence since it is energized only intermittently and exposed to air cooling. Inductive effects were overcome by twisting the circuit wires together, thus balancing the effect of one wire against the other. A lightweight pulley arrangement fastened to the supporting gear made it possible to fly the kytoon into position and then pull the lamp and wire circuit into position. In this way it was possible to vary the height of the lamp. By operating the switch it is possible to make the light blink, thus making it easier to see from a distance. A reel arrangement with hand crank was developed to facilitate winding-in the electric circuit wire. All equipment is effectively grounded by means of a driven ground prior to use at each location.

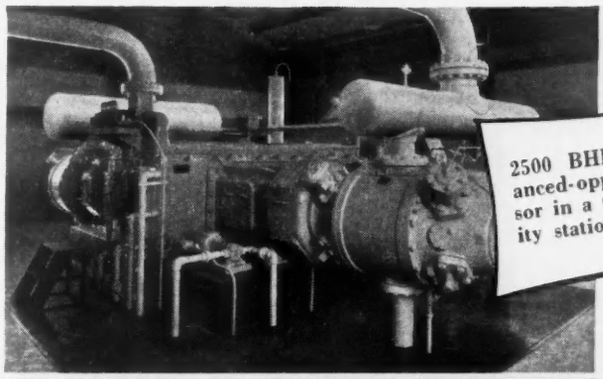
Several interesting things came to light in the process of development of the described rig. The first thought was to employ ten-minute magnesium or phosphorus flares attached to the nylon cord holding the kytoon. Tests run, using magnesium flares in the vicinity of Muskogee and Tulsa (a distance of 40 miles), indicated two things:

First, it was not possible to see the flare from the distance involved while the 250-watt photoflood bulb was easily seen. Subsequently, a test was made comparing the amount of light in candle power by means of a light meter from a ten-minute magnesium flare and a 250-watt photoflood light bulb. The results showed that the 250-watt photoflood bulb provided approximately four times the amount of light in candle power as compared to the flare; this in spite of the fact that the flare appeared brighter to the naked eye.

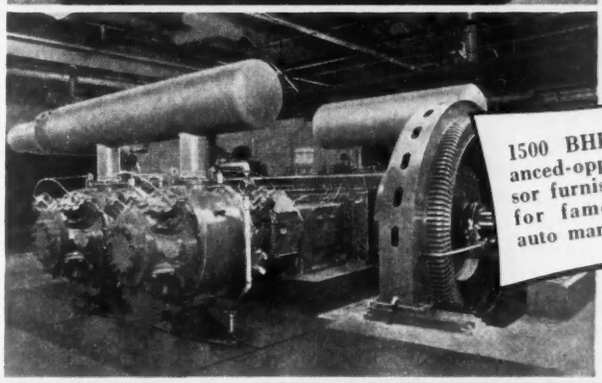
Second, droppings from the flares constituted a very real fire hazard, and since most of the survey was conducted in heavily wooded areas, flares were immediately discarded. Warning should probably be made at this point to be sure the area where use of such equipment is contemplated is free of power lines. Tests are not conducted in threatening weather due to the

Original installation on piling over Lake Maracaibo, Venezuela.

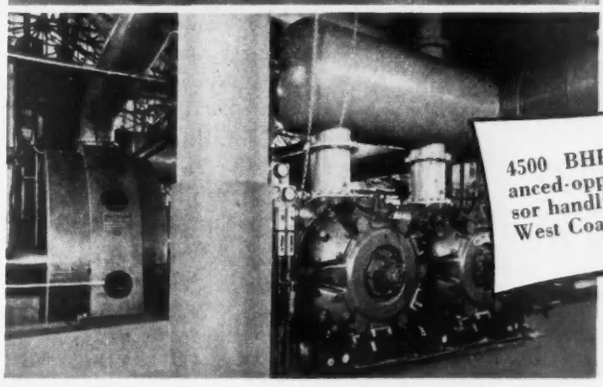
18 YEARS AGO...the first TODAY...still the first!



2500 BHP, 4 cyl. balanced-opposed compressor in a California utility station.



1500 BHP, 4 cyl. balanced-opposed compressor furnishing plant air for famous Michigan auto manufacturer.



4500 BHP, 6 cyl. balanced-opposed compressor handling mfd. gas in West Coast utility plant.

A Venezuelan oil producer ordered it, in 1932. The original heavy duty, balanced-opposed, motor-driven compressor. *A noteworthy Clark first!* And like 15 similar units added subsequently, it has delivered continuous, vibration-free service over the years.

In 1946 came a second major Clark development . . . a new line embodying components of the famous angle type compressor. Two, four and six-cylinder models in 8″, 14″ and 17″ stroke sizes broadened the range to cover 150 to 4500 BHP.

Today, Clark remains the pioneer, with continuing improvements in design and performance. *Data and illustrated catalog from your nearest Clark representative.*

SEE the difference in

CLARK®

balanced/opposed

MOTOR-DRIVEN COMPRESSORS

MIDGET ANGLE • RIGHT ANGLE • BIG ANGLE
ELECTRIC-DRIVEN • CENTRIFUGAL

CLARK BROS. CO., INC.
OLEAN, N. Y.

One Of The Dresser Industries

New York • Tulsa • Houston • Chicago • Boston • Washington • Los Angeles • Birmingham • Detroit • Salt Lake City • San Francisco
London • Buenos Aires • Caracas, Venezuela • Paris • Lima, Peru • Bogota, Colombia • New Delhi, India

lightning hazard. Also, line-of-sight tests are feasible only when visibility is good; just a slight ground haze could reduce visibility so that the target lamp could not be seen.

As previously indicated, the basemobile and line-of-sight field tests were run simultaneously by the same three-man crews. At proposed Tower Site 1 a 96-foot collapsible sectional aluminum antenna mast was erected and rope guyed at two points on the mast in three directions by means of a balanced pulley guying arrangement. Three men can erect such a mast in three hours. A transmitter-receiver unit in a vehicle cruises the area to determine coverage, keeping in contact with the first unit located at the antenna. Record is made of the limits of acceptable signal strength both day and night. By means of mobile radio communication, the observing crew at Site 1 informs the crew at Site 2 (where the kytoon lamp rig has been put in place) when the target lamp at Site 2 disappears from view below the horizon. This height is recorded by the crew at Site 2. This process is reversed with the target lamp at Site 1. With these measurements, as shown below, a simple calculation gives the minimum equal height of tower necessary at each location for acceptable line-of-sight. Tower heights for actual microwave installations should be determined only after exhaustive field tests using actual microwave equipment between doubtful points on the system. In the interest of an additional safety factor, calculated tower heights should be increased by an amount to clear any subsequent obstructions, either man-made, such as a building or other structure, or natural, such as tree foliage.

There follows the derivation of a formula for determining the minimum equal height of tower necessary at each location to clear one obstruction.

The equation, $h_x = \frac{h_1 h_2}{h_1 + h_2}$, used to determine the height of a single obstruction between two observation points is derived as follows. (See Figure 1):

Neglecting the height of the observer, h_x = the perpendicular distance between a line drawn from ground level at observation location "a" to ground level at observation location "b" and the top of an intervening obstruction at location "c."

h_1 = The minimum perpendicular distance above ground level at location "a" to which a source of light must be raised to permit observation of the light from location "b."

About the Author

EDWARD EUGENE HOWE, chief of the System Operation Branch of Southwestern Power Administration, was born in Washington, D. C. He is a graduate in engineering of Drexel Tech, Philadelphia. In addition to other experience in engineering, he spent 1947 and 1948 in the Far East, stationed in Seoul, Korea, where he was responsible for power production, transmission, distribution, and maintenance of the Seoul Electric Company, which served 300,000 consumers and employed 6000 Koreans. He joined SPA March 31, 1950, and is stationed at the Field Operations Center in Muskogee, Okla.

h_2 = The minimum perpendicular distance above ground level at location "b" to which a source of light must be raised to permit observation of the light from location "a."

Since the distance $D_1 + D_2$ is very small in comparison to the radius of the earth, angle "abc" and angle "bad" may each be considered equal to 90° for all practical purposes.

By rotating triangle "abc" 180°, using side "ab" as an axis, trapezoid "acbd" results and the relationships exist as shown in Figure 2.

Exhibit "A"

1) $\frac{h_1 - h_x}{D_1} = \frac{h_x}{D_2}$

2) or $\frac{D_1}{D_2} = \frac{h_1 - h_x}{h_x}$

3) $\frac{h_2 - h_x}{D_2} = \frac{h_x}{D_1}$

4) or $\frac{D_1}{D_2} = \frac{h_x}{h_2 - h_x}$

5) $\frac{h_1 - h_x}{h_x} = \frac{h_x}{h_2 - h_x}$

6) $h_1h_2 - h_1h_x - h_2h_x + h_x^2 = h_x^2$

7) $-h_x(h_1 + h_2) = -h_1h_2$

8) $h_x = \frac{h_1h_2}{h_1 + h_2}$

As can be seen from Equation 8, the distance between the observation points has been eliminated in derivation.

Example

Assuming field data as follows:

$h_1 = 150$ ft. and $h_2 = 200$ ft.

then

$$h_x = \frac{150 \times 200}{150 + 200}$$

$$= \frac{3 \times 10^4}{350}$$

$$= 86 \text{ Feet (Approx.)}$$

An amount, F, for a clearance factor should be added making the height of towers at each observation points (86 + F) feet.

In connection with the equations used for calculation, it is interesting that the equation for the determination of required equal tower heights at two points does not involve the distance between them. Examination of this equation indicates that once the magnitude of the towers of equal height is calculated, it is possible to assume the height of the tower at one location and by similar triangles secure the necessary height of the tower at the other location, the two heights not necessarily having to be equal.

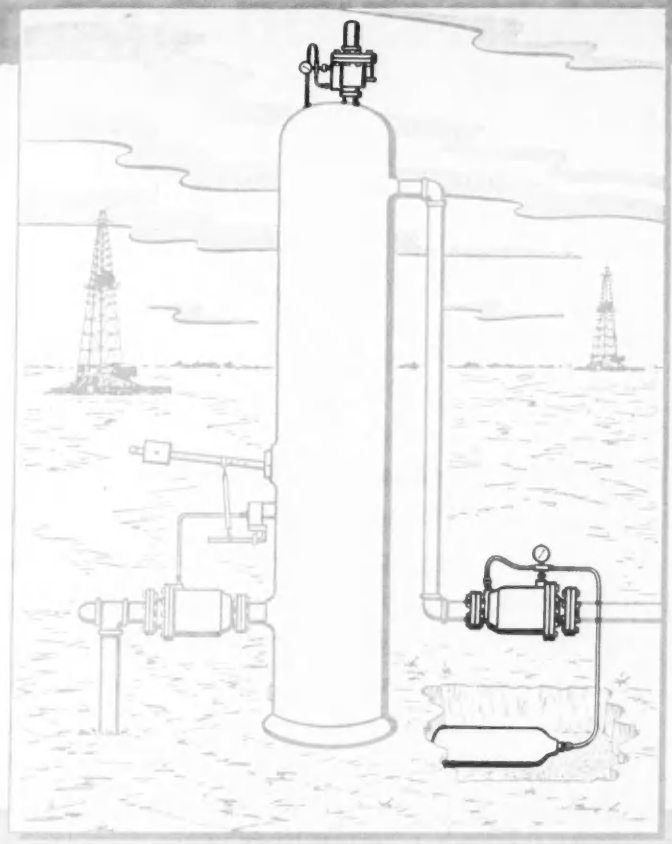
In lieu of calculation, a nomogram giving the height of an obstruction h_x, when h_1 and h_2 are known, may be constructed as shown in Figure 3.

1. Using either plain paper or graph paper marked in desired units, draw the line "D" any convenient length (the distance "D" does not affect Equation 1).
2. Draw perpendicular lines "A" and "B" and scale off in feet. To use the nomogram, mark off "h" and "h_2" on scales "A" and "B" as shown in Figure 1. Complete triangle as shown. "h_x" is then read as the perpendicular distance from "D" to the intersection of lines "ac" and "bd."

An interesting fact about the equation $h_x = \frac{h_1h_2}{h_1 + h_2}$ is that it is of the same form as the equation for calculating the equivalent resistance of two resistors in parallel. Such a nomogram can be used for the calculation of equivalent resistance of two resistances in parallel and then taking the equivalent resistance and combining it with another resistance for three in parallel. This process may be repeated for computation of equivalent resistance for as many resistors in parallel as desired.

GROVE

MODEL 888 PRESSURE LOADED RELIEVER



ON GAS SEPARATOR LINES

- HOLDS CONSTANT PRESSURE
- ASSURES TIGHT SHUT-OFF WITHOUT MOVING METAL PARTS

The unique operating principle of the Grove Model 888 Flexflo Reliever makes its action smooth and positive. This dependable service cannot be obtained from any other valve. There are no moving metal parts, springs, or weights to stick and jam. Pressure does the work, opening and closing the Flexflo Reliever with positive action.

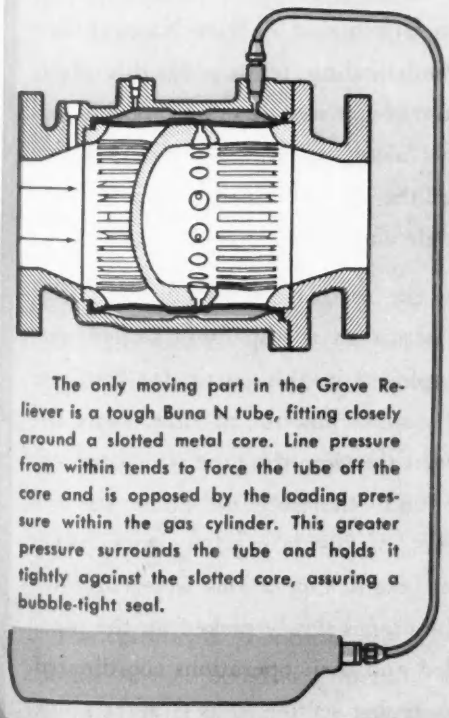
As a back pressure regulator, the Grove Reliever will unfailingly hold a constant pressure on the Separator and insure operation at maximum efficiency.

In the vent line the Grove Reliever will give dependable protection against excessive pressure and eliminate the expense and waste of leaking gas.

Specify Grove Model 888 Relievers with the proved Flexflo principle on your Separators for the best in efficient, trouble-free service.

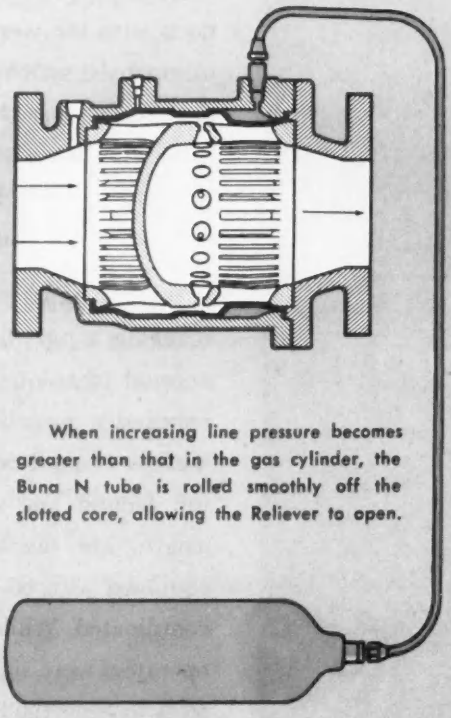
flexflo LETS PRESSURE DO THE WORK

CLOSED POSITION



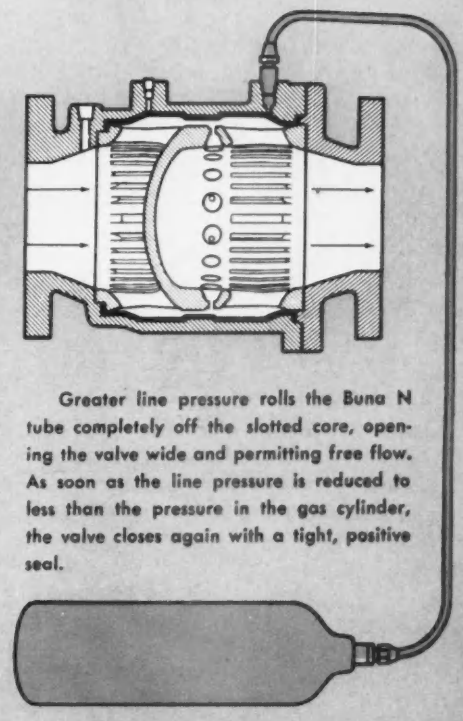
The only moving part in the Grove Reliever is a tough Buna N tube, fitting closely around a slotted metal core. Line pressure from within tends to force the tube off the core and is opposed by the loading pressure within the gas cylinder. This greater pressure surrounds the tube and holds it tightly against the slotted core, assuring a bubble-tight seal.

PARTIALLY OPEN POSITION



When increasing line pressure becomes greater than that in the gas cylinder, the Buna N tube is rolled smoothly off the slotted core, allowing the Reliever to open.

WIDE OPEN POSITION



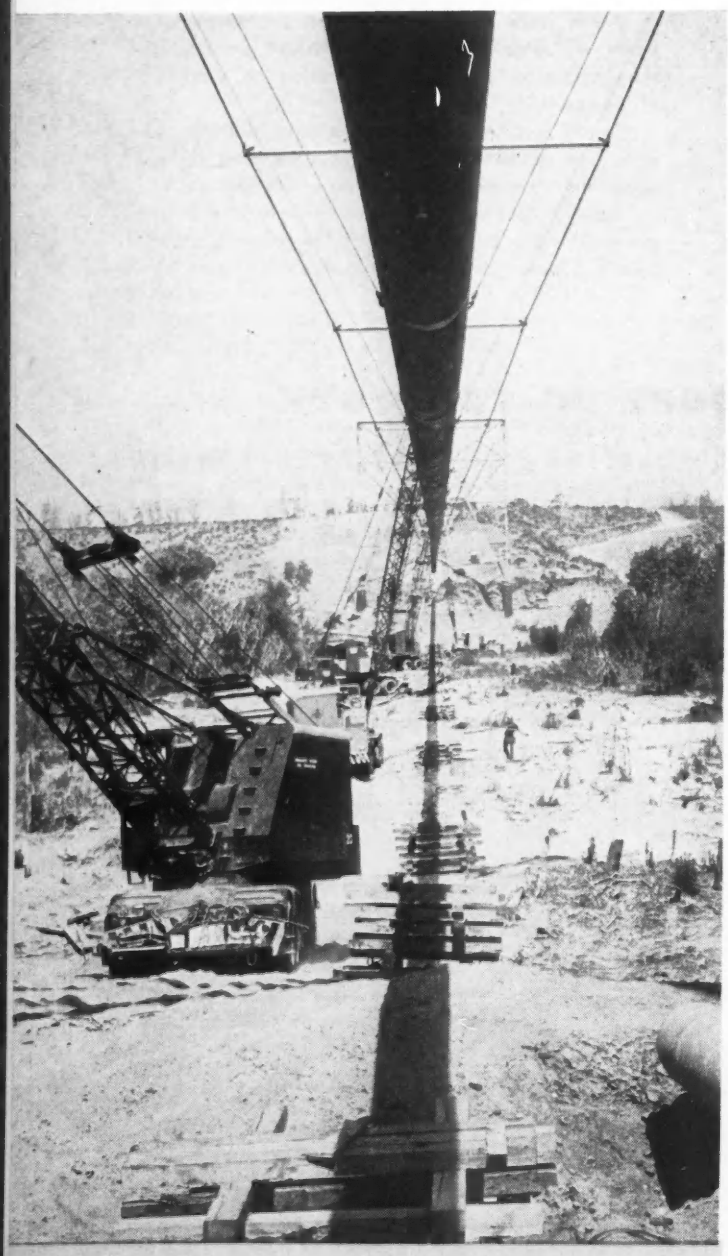
Greater line pressure rolls the Buna N tube completely off the slotted core, opening the valve wide and permitting free flow. As soon as the line pressure is reduced to less than the pressure in the gas cylinder, the valve closes again with a tight, positive seal.

GROVE REGULATOR COMPANY

1901 CALUMET, HOUSTON, TEXAS • 6529 HOLLIS ST., OAKLAND, CALIF. • 1930 W. OLYMPIC BLVD, LOS ANGELES, CALIF.

River Crossing Span

A DEPARTURE from the stovepiping method of putting the pipe into an overhead crossing involves welding the entire string and then lifting it high enough to be supported by saddles suspended from the cables. This novel method of bridging not only speeds up the operation, but enables the entire load to be placed on the supporting members without exceeding the dead-weight load of the pipe to be carried.



—U. S. Steel Photo

Lying directly across the river bed, the shadow of the elevated pipe takes almost the position in which it was welded on the cribbing. Tie-ins at the ends are of 90-degree bend type, and were welded to the crossing after main section had been slung from tension cables and aligned.

THE somewhat spectacular feat of hoisting a 750-foot continuous length of 22-inch gas transmission line pipe from the ground and securing it to hangers on a steel suspension bridge spanning a wide river bed, recently was accomplished successfully by rigging crews of Consolidated Western Steel Corporation. The suspension bridge job marked the completion of one of the final links in a recently-completed pipe line looping project designed to increase the quantity of gas flowing into the Southern California area through the transmission system of Southern California Gas Company and Southern Counties Gas Company. This system originates at the Arizona-California border where it connects with the western terminus of El Paso Natural Gas Company's system. Outstanding feature of this river crossing job was the use of five mobile cranes, positioned at equidistant intervals along the length of the section, to simultaneously hoist the 32½-ton load and hold it at the proper position while clamps were secured to it.

When compared to the more conventional system of stringing a pipe line across on a suspension bridge, the unusual technique employed in this particular instance required a surprisingly small amount of time. Only 55 minutes elapsed between the time the pipe was lifted off the ground and the final clamping up along its full length. The five cranes, of 20-ton capacity each, were equipped with 60-foot booms. Operations were carefully coordinated. While the cranes slowly picked up the pipe, operators were signaled and their operations coordinated so as to keep the long, limber section in as straight a line as possible until clamps could be bolted on and turnbuckles on the supporting cables adjusted. The maximum

Lifted as Single Unit

By GILBERT M. WILSON

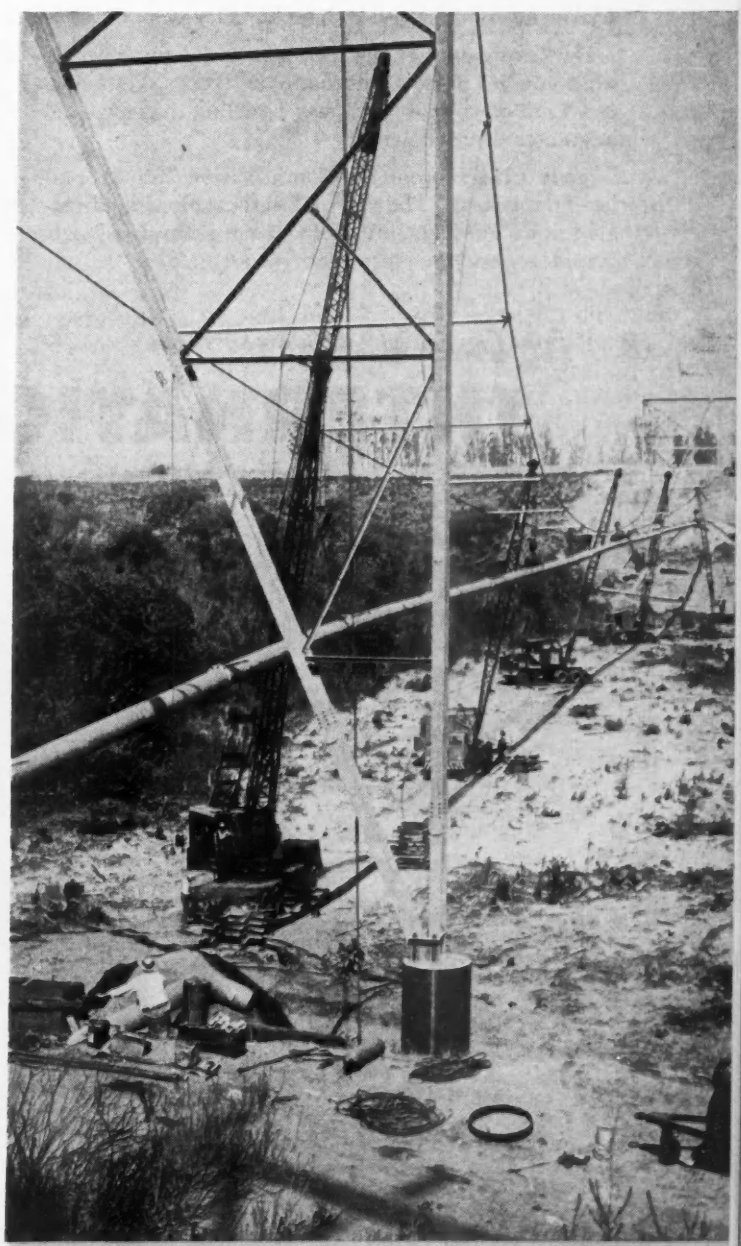
Pacific Coast District Editor

lift was at a point in the lower part of the river bed where the pipe was hoisted a total of 45 feet.

The section of pipe used in this crossing has a wall thickness of three-eighths inch and weighs approximately 87 pounds per foot. The pipe was coated with a zinc chromate compound and covered with aluminum paint. Previous to being hoisted into position, the pipe, in 30-foot lengths, was welded together and strung along on piles of timber cribbing of varying heights. The joints were welded in conventional manner and were X-rayed.

This particular river crossing, a point on the Santa Ana River about midway between the towns of Pedley and Arlington, is approximately 45 miles southeast of Los Angeles. The suspension bridge project was one of the final links in the construction of the 82-mile, 30-inch looping project completed jointly last fall by Southern California Gas Company and Southern Counties Gas Company. The looping, which started at Whitewater and proceeded westward, parallels approximately the course of the companies' original 214-mile, 30-inch gas transmission line completed in 1947 between the Arizona-California border and Santa Fe Springs near Los Angeles. The loop increases the over-all capacity of the California portion of the Texas-to-California transmission system to a total of approximately 405 million cubic feet per day. Additional compressor capacity was installed at the Blythe Compressor station at the Arizona Border.

The California portion of the Texas pipe line now is considered completed and, already, three years ahead of the original schedule, it is handling 100 million cubic feet more gas per day than was contemplated when the plans were drawn up four years ago.



—U. S. Steel Photo

The 750-foot long section of 22-inch pipe line was raised into position by five mobile cranes. Maximum height lifted was 45 feet. Only 55 minutes elapsed between start of lifting operations and clamping-up. Operation had just been completed when this photo was taken.

How to work an oil field

without winding up in the hole!

The more hauling you do, the more chance you have to save money with new heavy-duty engineered International Trucks.

"Heavy-duty engineered" means that extra stamina and durability are built into every International Truck part to give you through-and-through ruggedness. This assures you the money-in-the-bank savings in operation and maintenance that have kept Internationals first in heavy-duty truck sales for 18 years.

But heavy-duty engineered stamina is just part of what you get in new International Trucks. You get a new kind of comfort and easy handling that pays off in greater driver efficiency.

Your drivers ride in the Comfo-Vision Cab—"roomiest on the road." They sit on a soft-cushioned, adjustable seat. They get full front vision through a huge, one-piece, curved Sweepsight windshield.

And when your drivers put a new International through its paces on the job, they really enjoy no-strain steering. New Super-steering and Super-maneuverability give more positive control from a more comfortable position and permit turns in the shortest practical circles.

No matter what kind of oil field hauling you do, the world's most complete line of trucks has the right truck for you. 87 basic International Truck models range in GVW from 4,400 to 90,000 pounds.

Get the complete story from your nearest International Truck Dealer or Branch. Find out how to lick your hauling problems the money-saving way—with new International Trucks.

International Harvester Builds
McCormick Farm Equipment and Farmall Tractors
Motor Trucks . . . Industrial Power
Refrigerators and Freezers

Heavy-Duty Engineered **to save you money**

INTERNATIONAL TRUCKS

INTERNATIONAL HARVESTER COMPANY CHICAGO

Underground Storage

Of a Propane-Air and Natural Gas Mixture

By H. L. FRUECHTENICHT, General Superintendent, and JOHN B. SIMPSON, Engineer,
Michigan Gas and Storage Company, Jackson, Mich.

THE AUTHORS describe a process whereby propane was used to augment natural gas delivery, and the mixture of propane and air successfully stored underground along with surpluses of natural gas. The development offers a possible solution to the peak-load problem encountered by trunkline gas systems in year-round operation against widely fluctuating demands.

UNDERGROUND storage of a mixture of propane-air and natural gas helped solve an acute natural gas shortage. The plant was installed for Consumers Power Company by Michigan Gas Storage Company, Jackson, in Clare County, Michigan. It has been discontinued, but engineers report it did the job for which it was intended and experience gained may later be applied should a similar emergency arise.

The Michigan Gas Storage Company, a subsidiary of Consumers Power Company and Panhandle Eastern Pipe Line Company, normally receives large quantities of gas from Panhandle for storage in its Clare County underground gas storage field from May to October, inclusive. It also receives gas in lesser quantities in April and November and that not needed for the daily demand of its customer (Consumer Power Company) is stored also. Michigan Gas divides its year into two parts; input cycle from April to November inclusive, and output cycle from January to March inclusive, and the month of December.

Preliminary Studies

Coincident with a natural gas shortage in the area to be served was a shortage of steel which made it impossible to enlarge facilities of both Michigan Gas and Panhandle Eastern, so that full contract amounts could be delivered to Michigan Gas.

To meet this anticipated deficit, engineers of Michigan Gas and Consumers Power studied various methods of obtaining additional gas. Sources of natural gas in Michigan were limited and no new discoveries had been made for several years. Panhandle's capacity to make additional deliveries was found to be unavailable due to material shortages. High British thermal unit oil-gas to be made in several existing emergency standby plants was considered, but serious difficulties forestalled this plan. Installation of peak-shaving propane-air units at principal distribution points was also contemplated but the cost, amounting to several million dollars, was prohibitive and material shortages in this type of equipment were acute.

There finally emerged a plan to build one propane-air plant at storage fields having a capacity of 10 million cubic feet per day of propane air, and mix propane-air gas with large amounts of natural gas and store the mixture underground. The plant could be built for approximately $250,000 because part of the necessary equipment (compressors, boilers and mixing tower), was installed and available for quick conversion. This plan offered continuous operation of the propane-air plant and a uniform mixture immediately available for use when needed.

Pioneering Problems

As far as could be determined, mixing propane-air and natural gas for underground storage on such a large scale had never before been attempted, and some questions were raised as to recovery, vaporization, condensation, interchangeability and hydrate trouble to be encountered. Each of these factors was investigated and the theoretical conclusions showed the plan to be workable.

Construction included building a 1600-foot railroad spur, 6 unloading racks, and 2 steel buildings and installing 3 vapor compressors, 2 liquid transfer pumps, and a 30,000-gallon storage tank at the unloading station. A 4-mile, 4-inch pipe line, together with a 4800-volt, 3-phase power line and a private telephone line were built to connect the unloading station with the mixing station. The mixing station was incorporated with the natural gas compressor station injecting gas into the storage wells. A 30,000-gallon storage tank, two high-pressure liquid transfer pumps, a steam heat exchanger vaporizer, and

an 800 horsepower two-stage air compressor were installed. One 800 hp single-stage gas compressor located in the main compressor building was converted to a third-stage air compressor. One of the gas compressor station dehydration contact towers was changed to a propane-air-gas mixing tower and the necessary steam and water connections were made. Air lines, aftercoolers, intercoolers, a carbon and fire arrester and other auxiliary equipment were installed to complete the mixing plant. Figure 1 shows a diagrammatic plan of the system.

After the plant was completed and had settled into normal operation, six tank cars were unloaded at a time and the liquid pumped to the mixing station through the pipe line with the tank at each end acting as surge tanks and reservoirs to allow flexibility in the unloading and pumping rate. The propane in the storage tanks was used as a supply while the vapor was being removed from the tank cars and while tank cars were being switched to the siding or shuttled along the siding to the unloading points. At the mixing station the propane was then pumped to a steam heat exchanger for vaporization and then to the mixing tower.

During the warm summer operation the propane was bypassed around the vaporizer as the heat of compression of the air and the natural gas furnished the heat for vaporization of the propane. To vaporize 100,000 to 140,000 gallons of propane per day from 70° F to 193° F at 540 pounds per square inch absolute requires from 75 million to 106 million Btu per day. Natural gas, in being compressed from an average suction pressure of 200 psig to a discharge pressure of 525 psig, gave an actual discharge temperature of approximately 170° F without aftercooling. The specific heat of gas accounts for 24 Btu/Mcf/° F temperature change, and thus 40 to 60 million feet of gas being cooled from 170° F to the injection temperature of 70° F gave 95 million to 144 million Btu per day available from gas compression. The third-stage air in being compressed from 90 to 475 pounds per square inch gauge had an actual discharge temperature of approximately 375° F and about 35 million Btu per day were available from air compression. When operations started neither the natural gas nor air was aftercooled before mixing with the propane. However, operation proved that vaporization, by passing this hot gas-air mixture through the propane or the bubble trays in the mixing tower, did not follow the heat balance equations as the gas and air passing up through the liquid propane had a considerable atomizing or mist action. It was found that an inlet temperature of air and natural gas of 90° F regulated by the amount of aftercooling was all that was required to give the 70° F temperature desired for injection into the wells.

Air was furnished by a two-stage intercooled compressor taking 6 million cubic feet of air per day from atmospheric pressure and delivering the air at 90 psig to an aftercooler and then to one 800 hp single-stage compressor. The third-stage air was discharged at the same pressure as the discharge pressure of the natural gas going into the storage fields. The air merged with the natural gas just before it entered the mixing tower and then the mixture of natural gas and air bubbled up through the liquid propane. The resultant mixture of propane-air-natural gas leaving the mixing tower entered the field gathering system and passed down through the wells into a sand reservoir lying approximately one-quarter of a mile below the surface.

Properties of Mixture

The general properties of the mixture were as follows: from 100,000 to 140,000 gallons of propane were mixed with 40 to 60 million cubic feet per day of dry natural gas of 0.685 gravity and 1000 Btu and then air was added to bring the mixture back to approximately the same Btu content, namely, 1000 Btu. At the higher rates of propane use, 140,000 gallons or more, the 1000 Btu standard could not be maintained as the air compressor capacity was limited to 6 million cfd. The pressure on the mix-

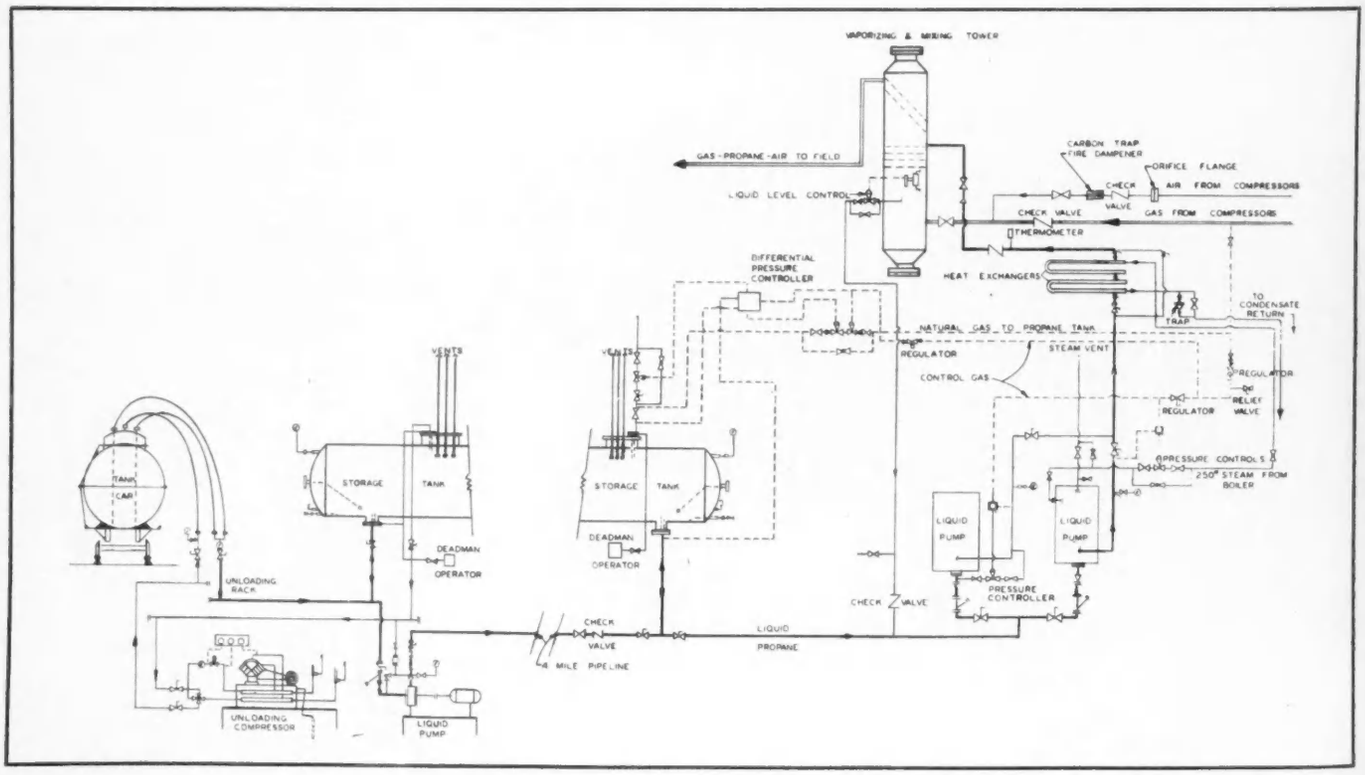


FIGURE 1

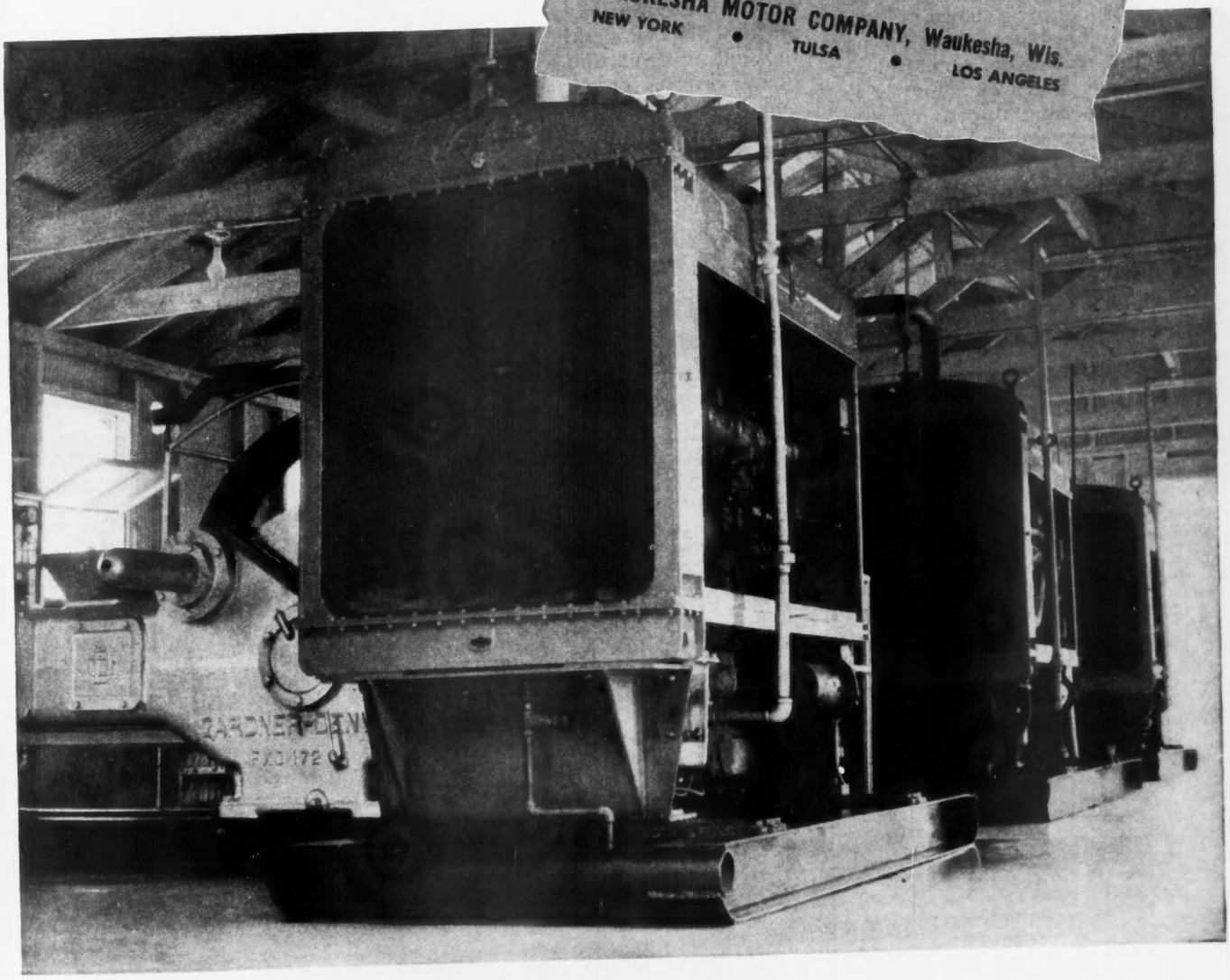
WAUKESHA POWER PUMPS

13,000,000 BARRELS!

● In the LION OIL COMPANY pipe line station at Magnolia, Ark., these three 145-GKU Waukesha Gas Power Units are working about 16 hours a day—driving 5 x 10 Gardner-Denver pumps operating at 700 pounds pressure. These Waukeshas have been in operation for four years or more, and during that time they have pumped 13,000,000 barrels.

That's real, rugged dependability. And it's built right into this six-cylinder, 5¼-in. x 6-in., 779 cu. in. Model 145-GKU with its hard alloy valve seat inserts, removable wet sleeve cylinders, gear-driven oil and water pumps, thermostat controlled cooling, precision bearings, husky 7-bearing crankshaft. For all the details—send for Bulletin 1225.

WAUKESHA MOTOR COMPANY, Waukesha, Wis.
NEW YORK • TULSA • LOS ANGELES



WAUKESHA Diesel Power... ...Gas Power POWER

ture varied from 400 to 525 psig in being compressed and stored in the field. The bottom hole or reservoir temperature was 60° F. The vapor pressure of the propane at this temperature was approximately 92 psig. The propane-air varied from approximately 15 to 25 percent of the total mixture and the propane varied from 6 percent to 11 percent. Partial pressures due to the propane varied from 31 to 58 psig and the propane therefore never condensed either in the field lines or in the wells, and no liquid propane was found in the wells or gathering system drips.

The average of spot-check analyses of the natural gas and of the mixture to and from the storage fields is shown in Table 1.

Table 1

Average of Spot Check Analyses

	Natural Gas Percent	Mixture To Fields Percent	Mixture From Fields Percent
Nitrogen and Non-Condensables	11.3	15.3	13.6
Oxygen	0.2	2.3	Trace
Methane	74.7	65.5	72.0
Ethane	13.7	5.8	6.6
Propane	....	10.9	7.0
Butane	....	0.1	0.6
Carbon Dioxide	0.1	0.1	0.2
Total	100.0	100.0	100.0

A hydrate equilibrium curve as experienced for the straight natural gas and also for the normal propane-air-natural gas mixture is shown as Figure 2. For straight natural gas at 540 psia the hydrate equilibrium point is shown on the Curve A as approximately 49° F. and in normal operation little trouble was encountered except at the wellhead or wellhead drip where there were restrictions with their subsequent cooling effect. An insulated wellhead house and indirect heater counteracted this cooling effect by maintaining a uniform temperature.

The hydrate equilibrium point for the normal propane-air-natural gas mixture at 540 psia as shown on Curve B is approximately 56° F. Some hydrate trouble was expected with the storing of the mixture, and consequently the wellhead temperature was maintained at or above 70° F. Out of a total of 293 storage wells some hydrate trouble was experienced in 37 wells. Temperature surveys in the wells revealed that a temperature of 49° F. was present between 600 and 700 feet and then rose gradually until it reached 60° to 62° F. at approximately 1335 feet. In these 37 wells hydrate bridges formed between 150 and 700 feet below the surface in the well bore and effectively blocked the flow of gas. Neither alcohol bottles nor shutting in the well removed the bridge, and the only effective method found was to open the well to atmosphere and let it blow the hydrate bridge out. The hydrate bridges occurred more frequently when an insufficient amount of air was added to the mixture to maintain 1000 Btu heating value. By some experimentation and review of previous operating data, an upper limit of 1030 Btu was set as the maximum allowable point and little hydrate trouble was experienced thereafter. The only control on the Btu range was the amount of air added to the mixture and it was limited to 6 million cubic feet per day. Some shipping delays necessitated a greater input of propane than was originally planned, and it was at these high input periods that trouble was experienced.

The high input rate of propane occasioned by the shipping and switching delays also created another problem. At times as many as 18 cars a day were unloaded instead of the 12 originally planned, so time spent in removing vapor from the cars became a limiting factor. During the hot weather the propane vapor being pumped from the tank cars would not reliquefy fast enough and the tank pressure would rise above 200 psig, thus causing the relief valve to open. It was not possible to install a refrigerating unit, so a water spray was attached to the tank using a relatively cold ground water and this helped to reliquefy the propane to a marked degree. This speed of unload-

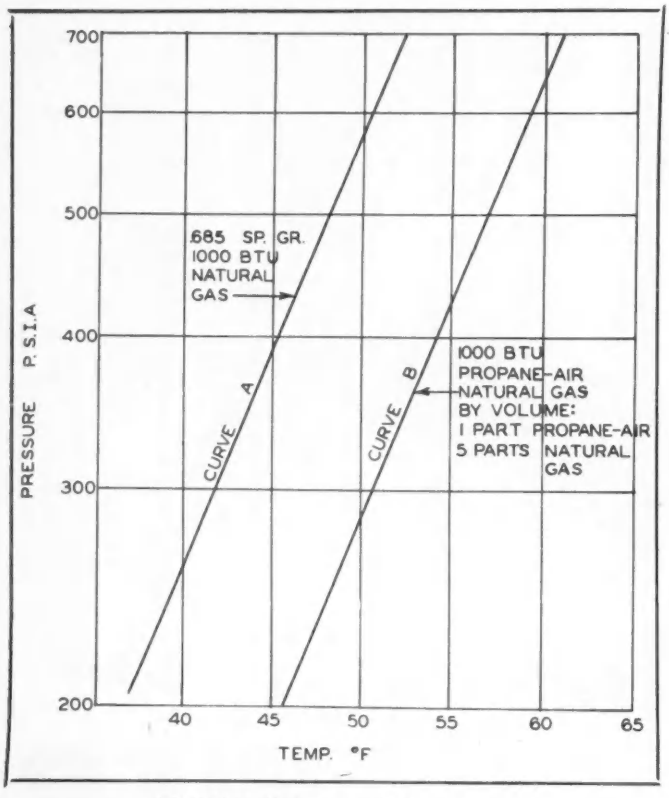


FIGURE 2. Hydrate equilibrium curve.

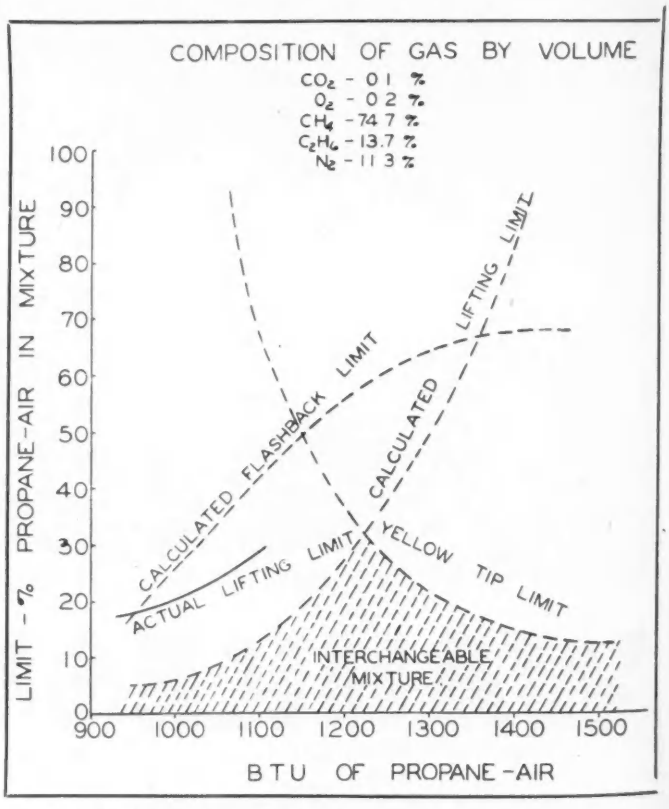


FIGURE 3. Interchangeability of propane-air and natural gas. (685 specific gravity and 1000 Btu.)

Why the *FIRST* names in pipelines depend on the *FIRST** name in line pipe

***FIRSTS by A. O. SMITH** • Welded line pipe Internal expanded pipe • Light wall large diameter pipe • World's largest producer of large diameter welded steel line pipe

• Creative engineering is a 76-year-old tradition at A. O. Smith. One of A. O. Smith's outstanding "firsts" is the internal expanding process that assures the roundness, straightness and accuracy of dimensions of A. O. Smith Line Pipe.

Here's what this means: line pipe is stressed beyond its yield point by uniform internal expansion—a process that produces higher yield strength. The result is line pipe that is lighter and stronger . . . yet requires no expensive alloy steel to obtain these desirable characteristics. It all adds up to a better line pipe that is simple and economical to weld—permits higher operating pressures—lower cost per mile.

A. O. Smith Line Pipe is available in a complete range of sizes and wall thicknesses, from 8⅝ in. to 36 in. in diameter.

A.O. Smith Proven Way Mile 76th ANNIVERSARY 1874 1950

DEPENDABILITY *through* **RESEARCH** *and* **ENGINEERING**

A.O.Smith

LINE PIPE • CASING

A. O. Smith Corp., Milwaukee 1 • Chicago 4 • Dallas 2 Denver 2 • Houston 2 • Los Angeles 12 • Midland 5, Texas. New York 17 • Phoenix • Pittsburgh 19 • Salt Lake City 1 • San Diego 1 • San Francisco 4 • Seattle 1 Tulsa 3 • Washington 6, D. C.

International Division: P. O. Box 2023, Milwaukee 1

ing and vapor trouble necessitated leaving many cars with 40 to 50 psig of propane vapor to go back to the shipper and increased the losses above those normally expected.

When the gathering system was installed in the field it was not cleaned by the use of a "pig," but was only purged and blown. The high rates of reverse flow and the oxygen content of the propane-air-gas mixture caused old scale to flake off and some new iron oxide to form and then fall off. This was carried to the wells and in some instances had to be removed by blowing the wells.

With a compression ratio of 5.2 at times in the third-stage air compressor, temperatures actually reached 375° F. or more. Excess oil in the compression cylinders formed particles of red hot carbon on the valves and deposited some oil in the air line. The carbon particles broke off and ignited the oil, causing fire inside the air pipe line and raised the temperature of the air going to the mixing tower in excess of 450° F. Careful regulation of lubricating oil did not entirely remove this hazard so an aftercooler was installed and the air cooled to 100° F. A fire dampener and carbon arrester was originally installed just ahead of the air-gas mixing point to keep any fire from the gas and propane. The total oxygen content of the mixture was 5 percent as a maximum and 17.7 percent was required to support combustion so no fire in the mixture was possible. The aftercooler installed at this time, together with the intercoolers originally installed, removed a considerable amount of water from the air and helped to reduce the quantity of water in the mixture stored in the field. It also offered another means of temperature control.

Suction Head Increased

To keep the high pressure, liquid propane positive displacement pumps from vapor locking in the suction valve ports it was necessary to increase the suction head. A natural gas pressure of 10 to 40 psig in excess of the vapor pressure of propane was imposed upon the mixing station storage tank by means of a differential pressure controller.

Interchangeability of the propane-air-natural gas mixture with straight natural gas was calculated to be allowable at 7 percent of 1000 Btu propane-air in the mixture as shown in Figure 3. However, experimental testing indicated a higher allowable percent mixture and it was believed that little trouble would be experienced with as much as 18 percent propane-air in actual practice. It developed that approximately 21 percent of the mixture was propane-air before trouble in utilization developed as experienced by trouble calls from customers.

During a 3½-month period in the input cycle (July 15-November 1), a total of 1194 cars containing 11,570,900 gallons of propane were handled. Losses due to various causes amounted to 427,520 gallons; therefore, 11,143,380 gallons of propane were vaporized and mixed with 556,358,000 cubic feet of air to make 960 million cubic feet of propane-air gas with an average Btu of 1060. This was mixed with 10,660 million cubic feet of natural gas to give the resultant propane-air-natural gas mixture a Btu value of approximately 1007 and a specific gravity ranging from 0.720 to 0.790.

During a four-month period in the output cycle (December 13-March 13), a total of 273 cars containing 2,783,920 gallons of propane were handled. Losses due to various causes amounted to 16,275 gallons; therefore, 2,767,645 gallons of propane were vaporized and mixed with 210,822,000 cubic feet of air to make 310,990,000 cubic feet of propane-air gas with an average Btu of 812. This was mixed with the propane-air-natural gas mixture coming from the storage fields, and the resultant mixture transmitted to markets averaged 1000 Btu. These two operations meant that most of the natural gas received from Panhandle during the summer for storage was enriched twice with propane. During this second period the propane-air percentage of the mixture transmitted to market at times rose as high as 22 percent at 1000 Btu. At this percentage some trouble was experienced with reducing atmosphere process furnaces raw gas pilots, and with a few home refrigerator burners; however, the number of service calls was not great and there were very few repeat calls. Higher gravities reduced the input to burners somewhat and in the case of space heating equipment, failure to adjust for higher gravity resulted in slightly lower efficiencies. The mixture caused no other disturbances and was utilized all winter. Propane was vaporized entirely by the steam heat exchanger and discharged into the suction of the gas compressors. No change was made in the air piping. During this type of operation the vaporization followed the heat balance equations perfectly and it was necessary to temporarily install an oil field boiler to supply the necessary steam to the heat exchanger.

Gas Tested

During the output cycle the composition of the gas was tested by Podbielniak analysis periodically and no really significant changes between the mixture put in storage and the mixture withdrawn from storage were noted. The specific gravity of the gas coming from the storage fields was a good index of the propane-air-natural gas mixture.

The total cost of the propane plant except for that material and equipment on hand and available for conversion and use was $252,000. Cost of the 14,354,820 gallons of propane, including freight to unloading station, was $1,576,100. The operating labor, material and supplies, and fixed charges amounted to $266,900. Total cost of the approximately 1271 million cubic feet of propane-air gas was $1,843,000 or an average cost of $1.45 per thousand cubic feet.

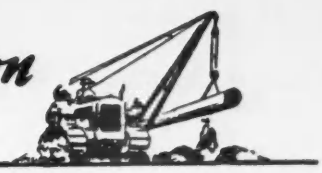
It is estimated that all of the propane-air gas was recovered from the fields except for a small amount which diffused with the cushion gas. Although the operating expense was considerably higher than for natural gas, it must be borne in mind that the plant was installed to meet an emergency, and all evidence shows that the project was highly successful from an operational standpoint.

About the Authors

H. L. FRUECHTENICHT, general superintendent, Michigan Gas Storage Company, Jackson, Mich., graduated from Speed Scientific School, University of Louisville, in 1929 with a B.S. in civil engineering. He spent a year with the U.S. Corps of Engineers, Memphis district; a year with Frick-Reid Supply Company; 15 years with Consumers Power Company; and joined Michigan Gas Storage four years ago.

JOHN B. SIMPSON, engineer, Michigan Gas Storage Company, graduated from Massachusetts Institute of Technology in 1940 with a B.S. degree in petroleum engineering. He spent two years with Stanolind Oil & Gas Company, 3½ years with the U. S. Navy, a year with Consumers Power Company, and joined Michigan Gas Storage four years ago.

PIPE LINE *Construction*



By SYLVIA LILLIE, Staff Writer

Projects Announced and Contracts Awarded

Crude Oil Lines

Gulf Oil Corporation, Cities Service Company, The Pure Oil Company, Sun Oil Company, and Standard Oil Company of Ohio plan 440 miles of 24- and 26-inch line to carry West Texas crude to the Gulf Coast. The 26-inch portion, with a capacity of 300,000 barrels per day, will run from Colorado City, Mitchell County, to Wortham, Freestone County. A 24-inch line will carry some of the crude to Sour Lake, near the Beaumont-Port Arthur refining district, while the remainder will be fed into Mid-Valley Pipe Line Company's system at Longview, Texas, and moved to the Sohio refinery at Lima, Ohio.

Progress Pacific Pipe Line Company is seeking the approval of Petroleum Administration for Defense of a 1050-mile, 24-inch line from West Texas to Long Beach, Calif., paralleled by a ten-inch products line. Capacity of the crude line would be 250,000 barrels per day, of the products lines, 65,000. Estimated cost of the entire project is $120 million. Reversal of flow would be provided for in both lines in case of emergency.

Sinclair Pipe Line Company is planning a 700-mile, 22-inch line from Drumright, Okla., to Chicago. The line, including six pumping stations, will cost $48 million and will have a capacity of 145,000 bpd.

Products Lines

Imperial Oil Company, Ltd., plans to build a 170-mile line from Sarnia to Toronto via Hamilton, Ontario, Canada.

Natural Gas Lines

City of Trinidad has been authorized by FPC to build 35 miles of eight-inch connecting the city with Colorado Interstate Gas Company's facilities. A distribution system will be built in Trinidad.

Cities of Ripley, Booneville, and Baldwyn, Miss., have authorization to connect their proposed facilities with Tennessee Gas Transmission Company's line. They will build 16 miles of six-inch from TGT's line to Ripley, and 22 miles of six-inch from Ripley toward Booneville and Baldwyn with a five-mile tap line to Baldwyn and Wheeler and a six-mile tap line to Booneville.

The East Ohio Gas Company applied to FPC for permission to build 65 miles of 26-inch from New York State Natural Gas Corporation's line near Petersburg into Twinsburg Township, Summit County, Ohio.

Equitable Gas Company asked FPC permission to build an 1100-horsepower compressor station in Washington County, Penn., for the purpose of increasing pressure in the Bunola pool up to a daily delivery capacity of 80 Mmcf.

Interstate Power Company applied for authority to build 26 miles of eight-inch from a connection with the facilities of Natural Gas Pipeline Company of America near Hooppole, Ill., to Clinton, Iowa.

Lynchburg Gas Company asked for FPC authority to build a 15-mile line from Transcontinental Gas Pipe Line Corporation's system in Appomattox County to a point in Campbell County adjacent to Lynchburg, Va.

Mississippi Power & Light Company asked permission from FPC to build 13 miles of four-inch between Pace and Rosedale, Miss., and 21 miles of four-inch southward from Coldwater, Miss.

Niagara Mohawk Power Corporation has been authorized by FPC to build a 55-mile, ten-inch line to provide gas service to Watertown from a connection with New York State Natural's line at Fulton, N. Y.

Northeastern Gas Transmission Company has applied to FPC for authority to extend its previously-authorized system to provide natural gas service to all New England towns and communities which Algonquin Gas Transmission Company proposes to serve, and to a number of additional communities in Massachusetts, eastern New Hampshire, and Maine. It would build approximately 441 miles of additional lines and an 8000-horsepower compressor station at an estimated cost of $14,029,224. The proposed system would have a delivery capacity of 414 Mmcf. Northeastern has also asked FPC approval of the substitution of a 24-inch line for the 20-inch line previously authorized on the 144 miles of the main system between the New York-Massachusetts state line near Pittsfield, Mass., and Boston.

Southwestern Virginia Gas Transmission Company asked FPC authority to construct a 17-mile line from Transcontinental's system just north of the North Carolina-Virginia state line to Martinsville, Va.

Tennessee Gas Transmission Company applied for FPC permission to increase its system capacity to 1425 Mmcf in order to export 115 Mmcf to Canada. The project would include the building of a 45-mile line from Buffalo, N. Y., to the U. S.-Canadian border near Niagara Falls; 170 miles of loop line along the TGT system between Texas and Kentucky; 96 miles of loop along its Kentucky-Buffalo extension; two new compressor stations of 8000 hp each; and the installing of 56,000 hp in existing compressor stations.

Texas Gas Transmission Corporation asked FPC permission to build a 3960-hp compressor station on its main 20-inch line near Shreveport. The station, estimated to cost about $1,046,000, would increase the daily capacity of the line from 190 to 238 Mmcf.

Transcontinental Gas Pipe Line Corporation has received temporary authority from FPC to install a total of 45,675 hp in compressor capacity at existing stations on its Texas-New York line. The project will increase the capacity of the system to 555 Mmcf daily.

United Gas Pipe Line Company applied for FPC approval of 12 miles of 14-inch extending from Pure's platform off the Louisiana Gulf coast southwesterly to a platform operated by Magnolia Petroleum Company, Continental Oil Company, and Newmont Oil Company; and 14 miles of ten-inch running south from this platform to another platform operated by Magnolia, Continental and Newmont. United has an application pending before the Commission seeking authority to construct a line into the Gulf of Mexico as far as Pure's platform.

United Gas Pipe Line Company has FPC approval to build a 16-mile, 16-inch line from its Koran gasoline plant site in Webster and Bossier Parishes to its Carthage-Sterlington line in Bienville Parish, La.

Utah Pipe Line Company has asked authority to construct 374 miles of 22-inch and 18 miles of 16-inch between Aztec, N. M., and Salt Lake City. Laterals would be built to serve communities along the route. The system would have a maximum capacity of 96 Mmcf.

Projects Starting

Natural Gas Lines

Arkansas Power & Light Company began work in January on a 30-mile, 12-inch line from Forest City to Helena, Ark. Tulsa Construction Company is the contractor.

Cities Service Gas Company is building nine miles of 26-inch in the vicinity of Pampa, Texas. R. H. Fulton & Company, Lubbock, Texas, is the contractor.

City of Athens, Tenn., is building 40 miles of one- to six-inch distribution line in the city. Modern Welding Company, Inc., Florence, Ala., started in January.

Delhi Oil Company started in January 70 miles of eight-inch between the Lopeno field, Zapata County, and Laredo, Texas.

Altgelt Construction Company, Corpus Christi, is the contractor.

Illinois Gas Company is building 18 miles of six-inch and 12 miles of eight-inch in the vicinity of Olney, Ill. L. R. Young Construction Company, Olney, is the contractor.

Phillips Petroleum Company is at work on 14 miles of 24-inch in Sherman County, Texas, and in Oklahoma. Arey-Phillips Construction Company, Hooker, Okla., started in late December.

Southeastern Michigan Gas Company is building 55 miles of 12-inch from Panhandle Eastern Pipe Line Company's system in Oakland County to Marysville, Mich., for distributing gas in Macomb and St. Clair counties. H. L. Gentry Construction Company, Jackson, Mich., has the contract.

Southern Indiana Gas & Electric Company is building 12 miles of 12-inch in the Evansville, Ind., area. L. R. Young Construction Company, Olney, Ill., is the contractor.

Tennessee Gas Transmission Company started in January a 25-mile, 12-inch line between Grand Chenier and Rollover, La. Favrot & Peterkin, Houston, is the contractor.

Projects Completed

Crude Oil Lines

Ohio Oil Company completed in January the first section of its Wood River-Lima line. Bechtel Corporation, San Francisco, completed 55 miles of 20-inch between Wood River and Patoka, Ill., in January.

Products Lines

Creole Petroleum Corporation completed in December ten miles of eight-inch from Catia del Mar to Nueva Caracas, Venezuela. Macco-Pan Pacific, Caracas, was the contractor.

Great Lakes Pipe Line Company completed in December 206 miles of 12-inch from Barnsdall, Okla., to Kansas City, Kansas. Forty-eight miles from Barnsdall to Independence, Kansas, were built by Sparling, Fowler, Murphy Company, Inc., Bartlesville, Okla.; 50 miles from Independence to Humboldt, Kansas, by Engineers Limited Pipeline Company, San Francisco; 53 miles from Humboldt to Paola, Kansas, by A. C. Holder Construction Company, Tulsa; 42 miles from Paola to the Kaw River near Kansas City by Engineers Limited Pipeline Company, San Francisco.

Natural Gas Lines

Commonwealth Natural Gas Corporation completed in December 200 miles of 12- and 18-inch from Virginia Gas Transmission Corporation's line in Greene County to the Norfolk, Va., area. Ray. L. Smith & Son, Inc., was the contractor.

Humble Oil & Refining Company completed in January 50 miles of eight-inch and ten miles of four- and six-inch from Trawick field, Nacogdoches County, to Tennessee Eastman Corporation's new chemical plant southeast of Longview, Texas.

Michigan Gas Storage Company completed 84 miles of 22-inch from Saint Johns to Marion, Mich. E. J. Mahoney Contracting Company, Mount Pleasant, Mich., was the contractor.

New York State Natural Gas Corporation completed in December 46 miles of 16- and 18-inch in the vicinity of Renova, Penn. Pipeline Construction & Drilling Company, Camp Hill, Penn., was the contractor.

Pennsylvania Gas Company completed in December eight miles of four-inch and 12 miles of eight-inch between its main line and a connection with TGT's system in Erie County, Penn.

Texas Eastern Transmission Corporation built 100 miles of 16-inch transmission line between Provident City and Baytown, Texas. Smith Contracting Corporation, Fort Worth, finished in December.

Trunkline Gas Supply Company completed in January 174 miles of 26-inch from Longville to Darnell, La., 33 miles of 20-inch from Longville to Lacassine, La., and 18 miles of 16-inch from Lacassine to Lake Arthur, La. Houston Contracting Company, Houston, was contractor for all three lines.

United Gas Pipe Line Company completed in January 50 miles of 30-inch between the Magnet-Withers field, Wharton County, and Missouri City, Texas. Texas-Louisiana Contractors, Fort Worth, built the line.

A. P. I. PIPE COUPLINGS

All Sizes and Types for Oil Field Use

LINE PIPE COUPLINGS A.P.I.
1/8" to 12"—Seamless and Special Processed—Black or Galvanized

PLAIN TUBING COUPLINGS A.P.I.
1" to 3"—Seamless

EXTERNAL UPSET TUBING COUPLINGS A.P.I.
3/4" to 3 1/2"—Seamless

CASING COUPLINGS A.P.I.
4 1/2" to 13 3/8"—Long or Short

HYDRAULIC COUPLINGS
1/8" to 3"—Seamless

REAMED AND DRIFTED A.I.S.I.
3/4" to 12"—Seamless or Spl. Processed

DRIVE PIPE COUPLINGS
3/8" to 12"—Seamless or Spl. Processed

Consult Our Nearest Quick Service Sales Office:

Albany, N. Y.—Albert L. Becker, 434 Clinton Ave.
Baltimore—Ted Barto, 2301 N. Charles St.
Boston—Wm. F. Bennett, 24 Spring St., Somerville
Buffalo—W. E. Spencer & Assoc's, 241 S. Elmwood Ave.
Chicago—Harry A. Jay, 122 So. Michigan Ave.
Denver—Earl H. Jones & Co., 1863 Wazee St.
Detroit—Thomas L. Osberger, 19451 Livernois Ave.
Erie, Pa.—R. J. Maggi, Box 711
Houston—Henry H. Paris Distributor, Inc., Bo 932
Kansas City, Mo.—Wm. J. Hebenstreit, 3122 Coleman Rd.
Los Angeles—James A. Riordan Co., 1400 Santa Fe Ave.
Minneapolis—Lin J. Krause, 200 Lumber Exchange
Newark, N.J.—Murray Eskin, Industrial Office Bldg.
New York—Henry Stein, 50 Cliff St.
Philadelphia—J. W. Worthington, 401 N. Broad St.
Portland, Ore.—Earl H. Jones & Co., 1233 NW 12th Ave.
Richmond, Va.—P. C. Abbott & Co., Mutual Bldg.
San Francisco—Earl H. Jones & Co., 1150 Folsom St.
Seattle—Earl H. Jones & Co., 619 Second Ave.

FACTORY 'PHONE: ELM GROVE 3296

WHEELING MACHINE PRODUCTS COMPANY

ELM GROVE STATION — WHEELING, W. VA.

Republic National Bank of Dallas

Statement of Condition, December 30, 1950

RESOURCES

Cash and Due from Banks	$139,309,919.87
U. S. Government Securities	56,947,845.52
State, Municipal and Other Securities	5,873,152.77
Stock in Federal Reserve Bank	825,000.00
Loans and Discounts	191,670,662.29
Bills of Exchange and Commodity Loans	38,035,372.42
Bank Premises and Equipment	2,336,588.35
Real Estate for Bank Expansion	2,423,241.69
Acceptances—Customers Account	9,713,999.33
TOTAL	$447,135,782.24

LIABILITIES

*Capital	$ 13,500,000.00	
*Surplus	14,000,000.00	
Undivided Profits	3,573,588.88	31,073,588.88
Reserve for Contingencies		2,503,728.19
Reserve for Taxes, Etc.		2,585,981.31
Acceptances—Customers Account		9,713,999.33
Deposits:		
Individual	255,581,674.26	
Banks	140,918,198.93	
U. S. Government	4,758,611.34	401,258,484.53
TOTAL		$447,135,782.24

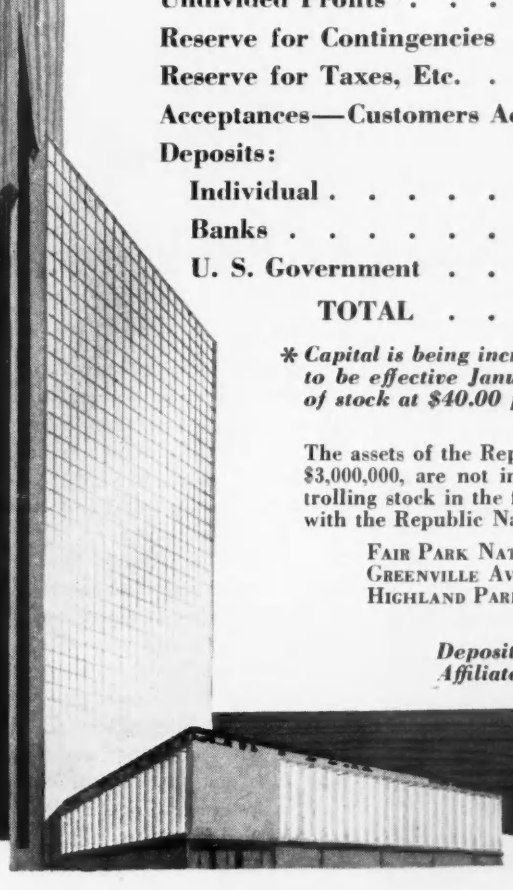
** Capital is being increased to $16,000,000 and Surplus to $16,500,000, to be effective January 8, 1951, by sale of 125,000 additional shares of stock at $40.00 per share, amounting to $5,000,000.*

★ ★ ★

The assets of the Republic National Company, including its capital stock of $3,000,000, are not included in above statement. The Company owns controlling stock in the following banks located in Greater Dallas, all affiliated with the Republic National Bank:

Fair Park National Bank — Lakewood State Bank
Greenville Avenue State Bank — National City Bank
Highland Park State Bank — Oak Cliff Bank & Trust Co.
Oak Lawn National Bank

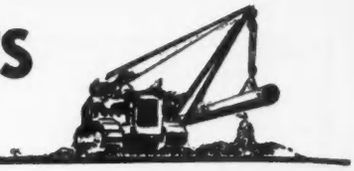
Deposits of the Republic National Bank and Affiliated Banks aggregate $498,026,471.84



MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

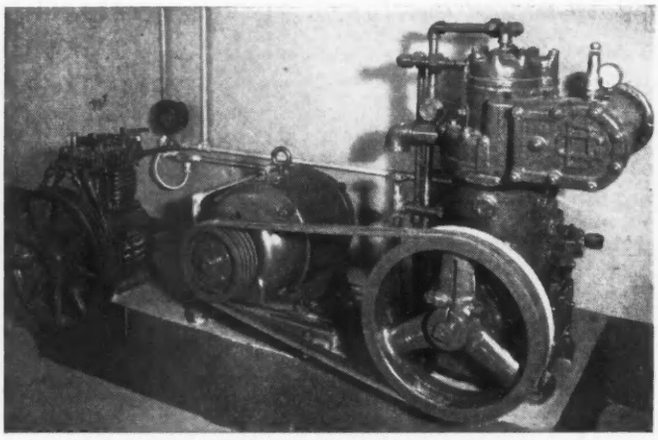
How to do it!

PIPE LINE HINTS



$10 is paid for each illustrated acceptable contribution. Mail to The Editor, WORLD OIL, P. O. Box 2608, Houston 1, Texas.

HOW TO—Insure Adequate Supply of Starting Air



Provision of a stand-by compressor for starting air in case the regular unit is down for overhaul is standard is most pipe line stations. One trunk line company, however, provides a source of air even though the station water system is down, which takes out of service the water-cooled (main service) compressor. The standby unit is air-cooled, but is set up on the same base as the water-cooled unit, with its V-belt sheave aligned with the motor pulley and the sheave of the other compressor. To change from one compressor to the other, the motor base bolts are loosened and the motor is slid toward the compressor it has been driving until the V-belts can be removed. The belts are then placed over the other driven sheave, and the motor adjusted until the desired belt tension is attained.

The conduit carrying the motor leads is bolted to the motor, and an extension terminates in a short section of flexible metallic conduit. This latter feature not only provides the right angled turn to the drop conduit from the switch, but also affords sufficient slack to accommodate the motor shifts as it tightens one or the other of the compressor drives.

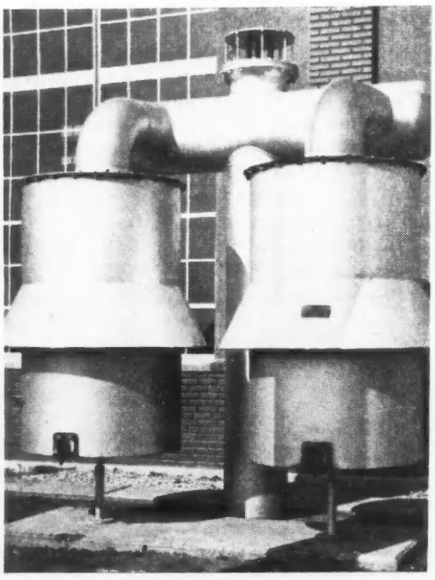
The mercury-level tilt-switch controlling current to the motor is set into the air piping so that it is under output pressure, regardless of which of the compressors is on the line. Excessive air pressure beyond the maximum limit set for the switch will cause the mercury to uncover the contacts and break the circuit.

HOW TO—Protect Air Cleaners Against Backfires

Energy released by a backfire is sufficient to damage severely the relatively light structure of the air cleaner and as a result most pipe line engine air intakes are equipped with some type of backfire release.

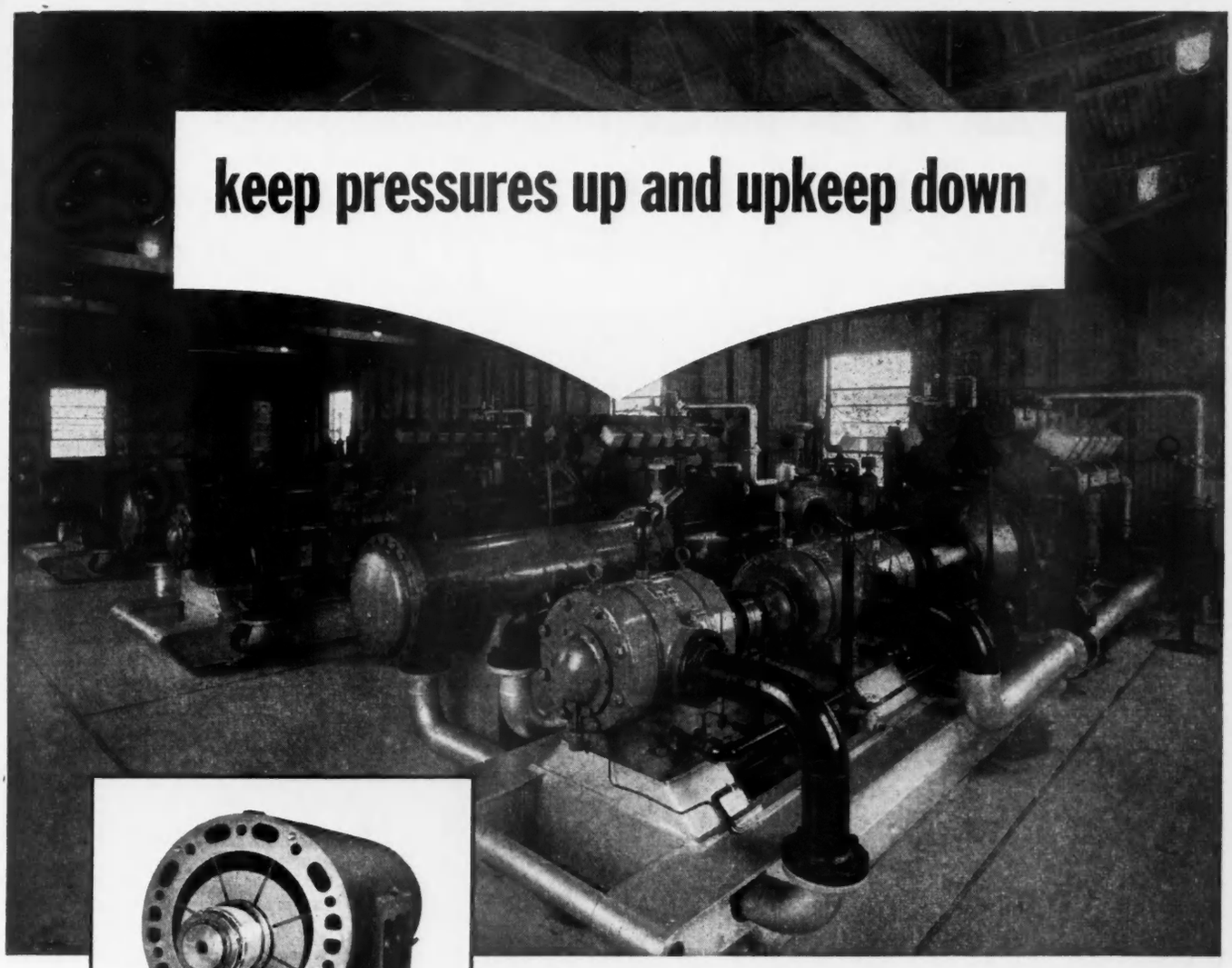
On one pipe line dual filters are used, with the air intake main being brought up vertically beside the cleaners, welded into the center of a lateral which is of greater diameter than the riser, and with the leads to each of the cleaner units taken off from the side of the horizontal cylinder and down into the top of the cleaner through an ell which is the same diameter as the intake riser.

In direct continuation of the riser on the upper side of the horizontal section of the intake system is mounted the conventional spring loaded release plate. Location of the plate in line with the bore of the riser insures that the energy or impact wave from the explosion, tending to travel in a straight line unless diverted, will strike and lift the release plate rather than make the wind through three right-angle turns to reach the cleaner units.



Unusual in this installation is the simple method of supporting much of the weight of the air cleaners. Rather than subject the welds in the piping to the entire load, single screw jacks were made to rest on a concrete pad covering the area below the cleaners. These jacks are merely short sections of one or 1½-inch pipe welded to a circular base. The upper end of the jack is fitted with a nut that was welded to the pipe. A second nut serves to lock the screw stem in position and prevent it from becoming loosened. Head of the jack is also a circular plate to the bottom of which is attached a ball and socket joint, the ball welded to the upper end of the shaft.

keep pressures up and upkeep down



Three two-stage Natural Gas Boosters in operation near Stinnet, Texas. Each direct-driven by a gas engine at 800 rpm., handles 1,770,000 SCFD, and boosts pressure from 10 to 120 psig.

Once again, Fuller Rotary Compressors have been chosen to give natural gas a king-sized boost. Texas gas men know when they install a Fuller Compressor that upkeep is low . . . that they'll get a life-time of dependable, continuous service.

There are no valves or other complicated mechanism in a Fuller Rotary Compressor. Moving parts—rotor, bearings, and blades—are few. Vibration-free, pulsation-free, and free from bearing take-up! Blades automatically compensate for wear, thereby insuring full compressor capacity for the life of the machine. It all adds up to one of the simplest and most efficient compressors available.

Fuller engineers are ready to offer estimates and plans for any compressor installation, whether for gathering lines or for general booster work. Write for Bulletin C-5 for complete information on Fuller Rotary Compressors.

FULLER COMPANY, Catasauqua, Pa.
120 So. LaSalle St., Chicago 3
420 Chancery Bldg., San Francisco 4

fuller

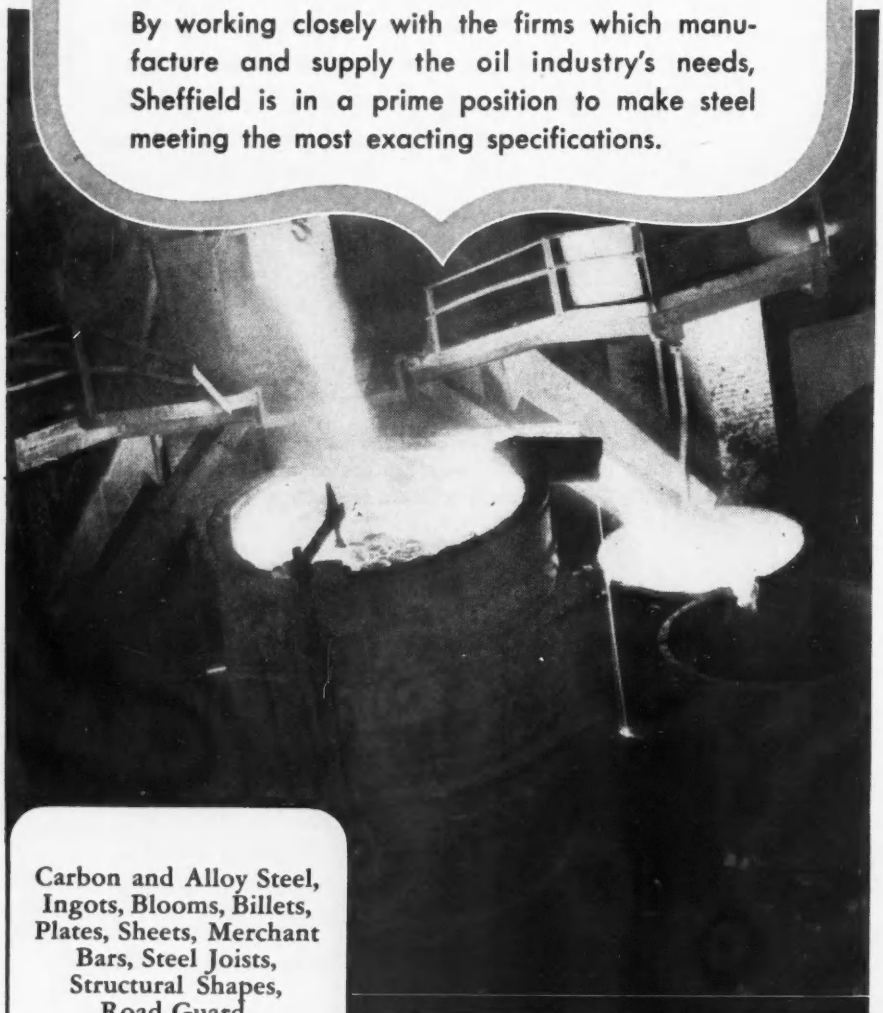
C-207

STEEL

From The Hearths Of The Oil Country!

From the open hearths and mills of Sheffield Steel, strategically located in America's greatest oil production area, comes steel for the oil industry. Sheffield steel makers and technicians, long experienced and familiar with requirements, make hundreds of different types and shapes of steel to specifications in Sheffield mills at Houston and Kansas City. Semi-finished and finished products are supplied to manufacturers of oil field equipment and distributors of steel products.

By working closely with the firms which manufacture and supply the oil industry's needs, Sheffield is in a prime position to make steel meeting the most exacting specifications.



Carbon and Alloy Steel, Ingots, Blooms, Billets, Plates, Sheets, Merchant Bars, Steel Joists, Structural Shapes, Road Guard, Reinforcing Bars Welded Wire Mesh, Wire Products, Wire Rods, Fence, Spring Wire, Nails, Rivets, Grinding Media, Forgings, Track Spikes, Bolt and Nut Products

SHEFFIELD STEEL
CORPORATION
HOUSTON KANSAS CITY TULSA

DISTRICT SALES OFFICES: Chicago, Ill.; St. Louis, Mo.; Des Moines, Ia.; Omaha, Nebr.; Wichita, Kans.; Denver, Colo.; Oklahoma City, Okla.; Dallas, Tex.; San Antonio, Tex.; Lubbock, Tex.; El Paso, Tex.; New Orleans, La.; Shreveport, La.

HOW TO—

Make Simple Device For U-Bolt Bending

The suspension of many different sizes and types of tubes and pipes during the construction of any pipe line compressor station requires hundreds of various sizes of U-bolts. Here is a shop-made device that enables the construction crew to fabricate its own U-bolts in many different sizes. After experimenting with various designs of jigs and mandrels, one was built that could be operated by one man with the assistance of a common jaw vise. One jig was made for two-inch U-bolts, and similar jigs were made for smaller and larger bolts.

The two-inch unit requires a length of heavy tubing for a handle. A lug welded to one side near the end of the pipe contains a tube through which the bolt is inserted. The bolt passes through a matching hole in the lug. A close-fitting sleeve attached to the handle slips over the end of the pipe with a stop which matches the hole in the mandrel lug and one on a similar lug on the rotating sleeve.

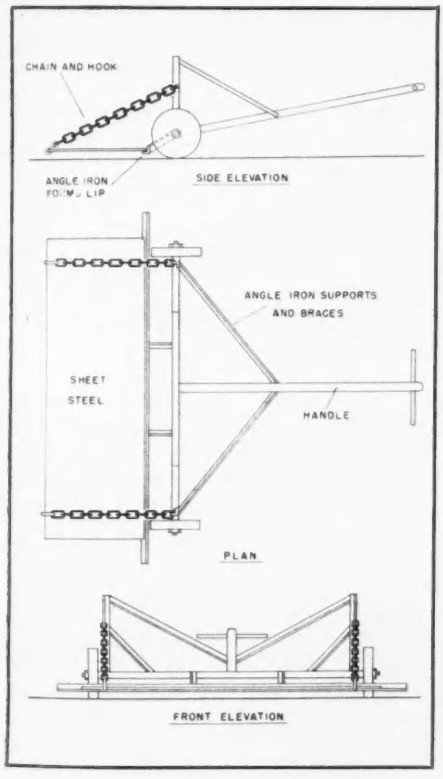
An extension of the sleeve lug stands upright pressing against one side of the straight hole being formed into a U-bolt. The stock, a straight, double-end threaded bolt, is fitted with a nut and inserted upward through the matching holes. Turning the sleeve with the long handle shapes the U-bolt to the correct turn. A second stop on the opposite side prevents forming a fitting with a greater bend than required for a normal U-bolt.

HOW TO—

Facilitate Repair Of Storage Tanks

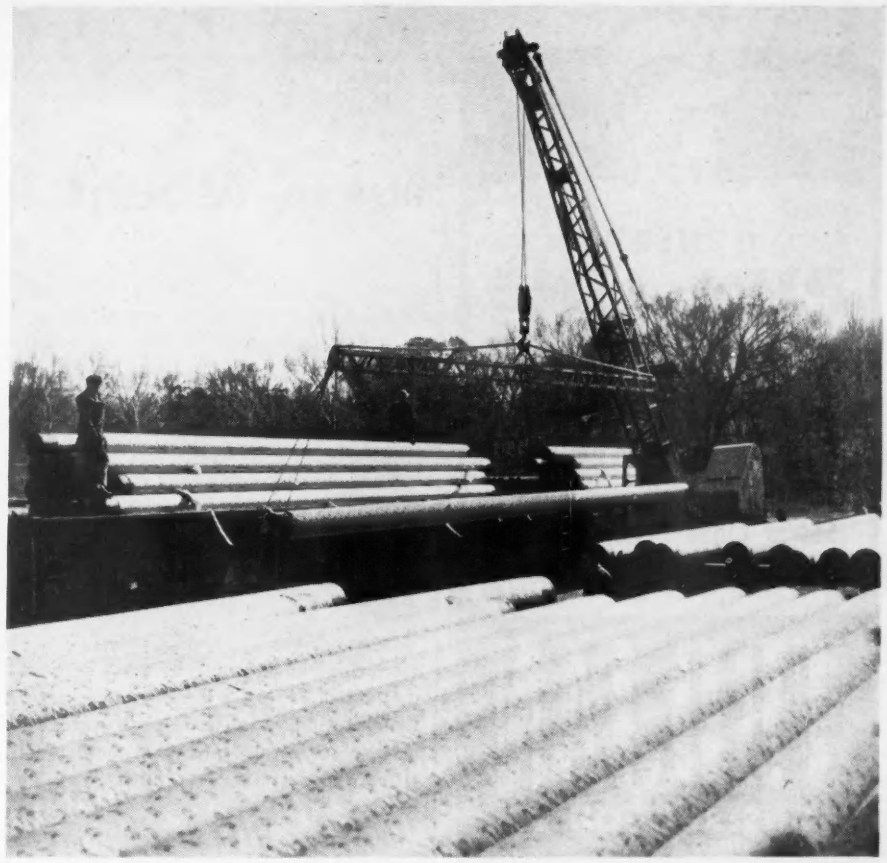
Handling sheet steel in constructing and repairing storage tanks is a difficult job that often requires use of much heavy equipment and erection of hoists and winches. One piece of equipment currently in use is designed to simplify moving steel plate into position on tank roofs. The buggy is illustrated in the drawing. After the sheets have been lifted to the roof of the tank, they are picked up with the buggy and moved to the location where they are needed.

The buggy consists of two wheels and two vertical angle iron posts, to which the handle and supporting frame are connected. The axle supports a lip section of angle



iron parallel to the axle a few inches from the roof. One side of the sheet of steel being moved rides on the lip, and the other side of the sheet is lifted by hooks on the chains connected to the frame. When the sheet has been loaded on the buggy, downward pressure on the handle lifts the sheet clear of the roof and the buggy is pulled or pushed to the desired location.

(Courtesy of "Coin Your Ideas" Committee, Esso Standard Oil Company.)

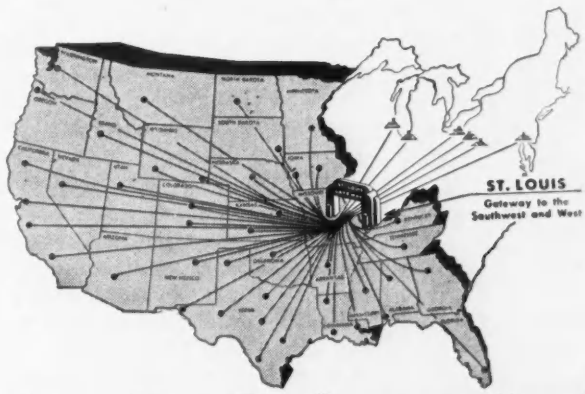


PROTECTION FOR YOUR PIPE WHILE EN ROUTE TO YOU

STANDARD PROCEDURE . . . for shipping your pipe, is to nest it with extra excelsior padding and strap it into one unit . . . all in accordance with Association of American Railroads specifications.

REINFORCED PAPER COVERING . . . protects each load to prevent cinders and dirt from scuffing the coated and wrapped pipe . . . and to provide for weather protection . . . an added service of ***standard pipeprotection inc.***

STORAGE-IN-TRANSIT . . . permits stop-off for processing or storage at St. Louis without freight penalty. When you ship through the St. Louis gateway, you enjoy "through freight rates" instead of the higher combination rates generally used.



standard pipeprotection inc.

3000 South Brentwood Blvd. • St. Louis 17, Missouri

GENERAL
PIPE LINE
CONTRACTORS

Personal Supervision on
Construction of Your

Pipe Lines • Water Lines
Sewer Lines • Excavations
Salt Water Disposals

TROJAN
CONSTRUCTION CO.
INCORPORATED
OKLAHOMA CITY, OKLA.
BOX 4427 • PHONE 2-7696
WAREHOUSE PHONE 6-1430

OIL WELL
DRAINAGE

By STANLEY C. HEROLD

Oil Well Drainage is a practical book written in an easily readable style, fully supported by actual citations of field examples, expressly for geologists, engineers, landowners, and operators of producing oil and gas properties, for they meet directly the financial issues of the industry. It is confined to the problem with which they are primarily concerned — drainage.

Oil Well Drainage is planned for maximum reference value. Each chapter is divided into two parts, one each for two types of wells with distinct features in drainage. In the outer margin of each page the subject content of the paragraphs is indicated, so that it is possible to locate in a minimum of time the particular information wanted.

Contents: Introduction; Typical Artificial Reservoirs; Natural Reservoirs; Reservoir Energy; Function of Gas; Radius and Area of Drainage; Regional Drainage and Water Encroachment; Drainage Across Property Lines; Effects of Stratigraphy and Structure on Drainage; Effects of Reservoir Penetration on Drainage; Effects of Multiple Zones on Drainage; Effects of Rates of Production on Drainage; Effects of Field Development on Drainage; Drainage by Wells of All or No Gas; Injection of Gas, Water, or Oil; Reservoir Content, Ultimate Recovery and Reserves; Abandoned Oil and Gas; Curtailment, Proration, and Conservation; Conclusion.

460 PAGES, 7 x 10 INCHES, $5.00

SEND ORDERS TO THE

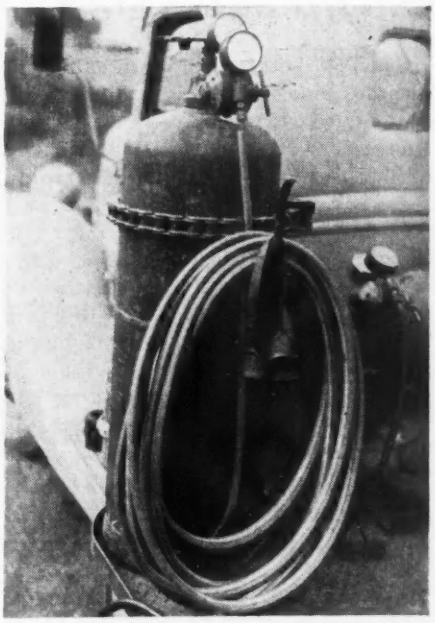
GULF PUBLISHING CO.
P. O. DRAWER 2608, HOUSTON, TEXAS

HOW TO—Mount Acetylene Bottles

An inexpensive yet efficient method of securing the oxygen and acetylene bottles to the welding truck is used in the installation shown. Two lengths of light channel iron are set up vertically, side by side, and the two adjacent sides welded together, so that, when seen from the top, they will conform in some degree to the curvature of the bottle. With this back post welded rigidly in position, a length of oil field roller chain, fitted with a bolt and nut take-up device on the free end, then is installed in the manner shown.

Base of the bottle is set in a socket mounting welded to the truck bed. This method of carrying the bottle creates very little, if any, waste space on the truck bed, is easy to install on any type of welding truck and permits easy, quick changing of bottles.

Two oxygen bottles carried in a horizontal position may be seen in the extreme right of the illustration. A channel iron rack was welded to the deck of the truck bed and a second rack elevated some 12 inches from the lower rack. Both bottles are clamped in place by the roller chain device and can be placed in the rack from the right-hand side of the truck.

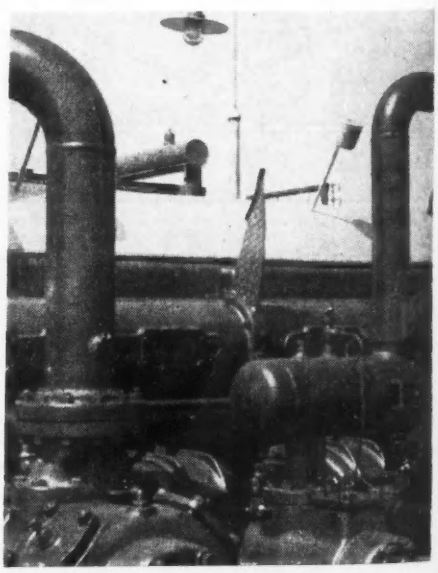


HOW TO—Add Cover to Compressor

Where packaged compressor units are used in limited field service, it is advantageous to cover the engine with a curved hood. This hood, made of galvanized sheet metal, is hinged along one edge and anchored to the upper edge of the exhaust manifold where a straight edge is available.

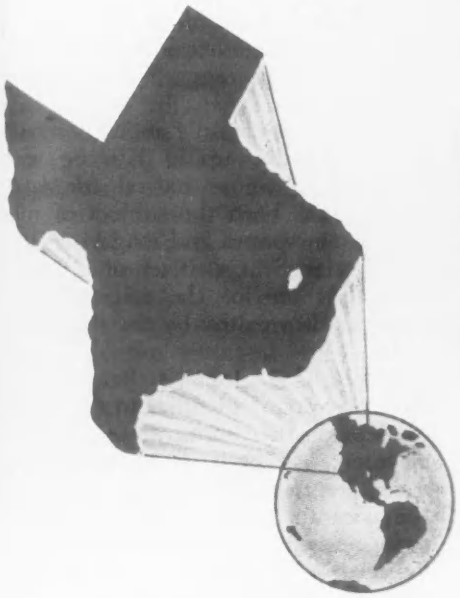
To facilitate lifting and lowering the relatively heavy cover, it is equipped with counterweights, one of the pair of suspended weights can be seen to the left of the second stage compressor exhaust line. The sheet metal covering is attached to angle-iron framework. Both rod supports for the counterweights are welded to cross-braces of the framework. These weights extend about 14 inches from the curved hood to make the job of lifting the hood considerably easier.

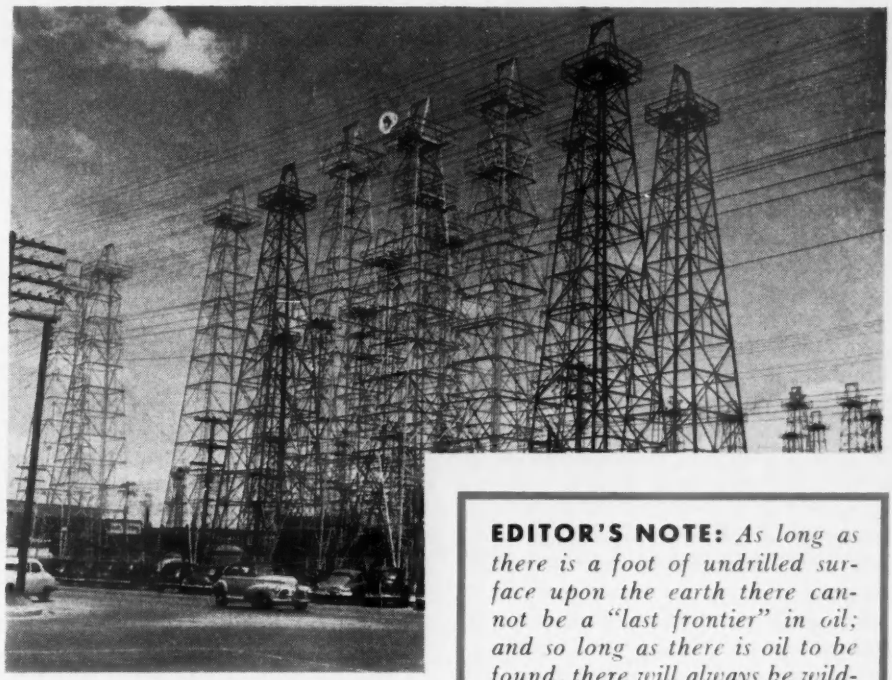
A back rest for the cover hood is also included in the installation. It is shown between the intake and exhaust lines from the compressor. This back rest is made of floor plate material and cut to fit the curvature of the hood. It is anchored by bolting to one side of the exhaust manifold flange where these two sections come together. A small flat steel strap welded to the back rest increases the bearing surface. This rest prevents the hood from falling back too far and out of reach of the operator. Such an installation protects the engine from weather, and saves the cost of an entire building.



KINGDOMS OF OIL

No. 1





Twenty-four wells sprout from a half-block in the business district.

EDITOR'S NOTE: *As long as there is a foot of undrilled surface upon the earth there cannot be a "last frontier" in oil; and so long as there is oil to be found, there will always be wildcatters—the men driven by restlessness, curiosity, the desire for gain, and the willingness to gamble their next meal on the turn of a drill bit. These are the men who build the Kingdoms of Oil. With this article* WORLD OIL *begins a series of descriptions of life as they find it, and life as it is lived in their wake, our purpose being to further commemorate their feats and to inform those in the oil business elsewhere of "how the other half lives."*

KILGORE, TEXAS

By JOSEPH P. ELLIS

Kilgore News Herald

AT ALMOST any time prior to Dec. 28, 1930, a scatterload shotgun blast fired down what passed as the principal thoroughfare of the tiny East Texas village of Kilgore might not have harmed a soul.

It never had been exactly a bustling metropolis, this sleepy little community, but in 1930 it was reeling from the effects of a nationwide depression.

Cotton was selling for next to nothing. Nobody was making a fortune in lumber, either. And the same was the story for hogs, cattle, sweet potatoes, spuds and other hard-grown products of the area.

Momentous deception hid behind the dawning of that Dec. 28, a Sunday.

It started as an ordinary winter day, with church as usual on the minds of most of the inhabitants, but by nightfall the complexion of things had undergone a complete metamorphosis.

Oil, that fabulous fortune-maker which keeps the wheels of progress rolling, was the transformer.

Among the regular churchgoers attending services that morning was 63-year-old Mrs. Lou Della Crim. She couldn't be bothered because there was a possibility that oil might be discovered on the family land about three miles south of Kilgore in Rusk County.

Her Lord came first.

She couldn't be bothered, but the possibility of the discovery of oil suddenly became a monstrously exciting actuality. The Lou Della Crim 1 blew in for more than 20,000 barrels of crude per day.

This marked the rebirth of Kilgore, a hitherto unknown village which promptly became the "Capital of the World's Largest Oil Field."

When the easy-going citizens of the erstwhile peaceful village awoke the morning after the Crim 1 came in, they found their community choked with an incredible mass of humanity. Normally a whistlestop of about 500 citizens, its population swelled overnight to an estimated 5000, an astonishing tenfold expansion in only 24 hours.

The tiny hotel, its lobby overflowing with cots, couldn't begin to accommodate the countless seekers of

lodgings. Tents and campfires sprang up everywhere.

Nobody knew where the avalanche of "visitors" had come from. Some were honest—job-seekers, leasehounds, oil scouts, enterprising businessmen. Then there were those who weren't so honest—sharpies and hustlers of every type, crooked gamblers, women of shadowy background, conniving big-dealers itching to make a killing.

Kilgore and a number of adjacent towns immediately became a chaotic jumble of get-rich-quick schemers enveloping the old-timers, bewildered by what had happened to the serenity of their home town. Hijackings became commonplace. Murders were accepted as an inherent part of the boom. Bootlegging was rampant. Vice vied with frenzied leasing activities for popularity.

Through it all, the solid citizens maintained their code of respectability. When possible, they remained aloof. If necessary, they mingled.

Many became phenomenally wealthy. Others landed in the well-to-do class. But for some the cards didn't fall so well. Their property happened to skirt the edges of the gigantic East Texas field which had been discovered in September by C. M. (Dad) Joiner's Daisy Bradford 3 and extended 11 miles northward in December by the Crim 1.

Wealthy or not, the natives clung to their home town. To be found in the thriving and charming Kilgore of today are the same names prominent there a half-century ago.

They have a fierce pride in their little city, and they have cooperated zealously with relative newcomers to build it into what they consider the finest in the world.

The population of Kilgore (1950 census) is 9693.

Among other things, it is noted for its "forest of steel derricks." More than 1150 wells have been drilled within the boundaries of the wealthy town that sits on top of a reservoir which once contained more than 5 billion barrels of petroleum.

Early Days

Kilgore's beginning was exceedingly humble. It was founded in 1872 by Constantine Buckley (Buck) Kilgore, an attorney who had fought with distinction as a Confederate soldier.

He started the town that was to bear his name by moving about five miles westward from the community of Danville to build his home at the terminal of the newly-extended International and Great Northern Railroad line. He was joined shortly by many of his former neighbors.

The settlement grew with vigor, a quality it may have inherited from its founder. Several years after establishing the town, Kilgore was elected by his Democratic constituents to the U. S. House of Representatives. He gained fame of a unique nature when he kicked down the door of the House chamber after the Republican speaker had locked the door to insure a quorum.

For many years, the I&GN maintained headquarters at Kilgore for the purchase of railroad cross ties. This, along with farming and lumbering, brought on a population increase to about 300 in 1880, eight years after it was established.

The land wasn't rich, but farmers managed to scratch a living. There was no reason for sensational growth, with the result that the population hardly doubled in the succeeding 50 years.

As the eventful boom year of 1930 approached, activities in Kilgore were those of a typical East Texas farming community. Business life revolved around five general stores, a cafe, a hardware store, two grocery stores, a lumber mill, a bank, a small hotel. There was no newspaper.

A small movie theatre, operated by a young man who was cashier at the bank, admitted the public for Friday and Saturday night shows. Additional recreation during summer months was provided by youths of the community who banded together into a baseball team to play aggregations from nearby points.

Probably the most famous baseball player to grow up in Kilgore was John King, whose hatred for left-handers has been the subject of numerous newspaper and magazine feature stories. Still a citizen of Kilgore, King was one of the original residents made wealthy by the discovery of oil.

When Dad Joiner's Bradford 3 found oil about 14 miles to the south on Sept. 5, there naturally was a stir of interest in Kilgore. No one there even dreamed of the immensity of the pool that had been tapped, but some nourished the hope of a similar experience. Among these was J. Malcolm Crim, a merchant.

He had been trying for years to interest oilmen in the Kilgore area, and in 1920 had gone so far as to obtain tentative leases on about 20,000 acres, including the farm of his mother, Mrs. Lou Della Crim, and to offer them "on a silver platter" to any operator who would just drill a well.

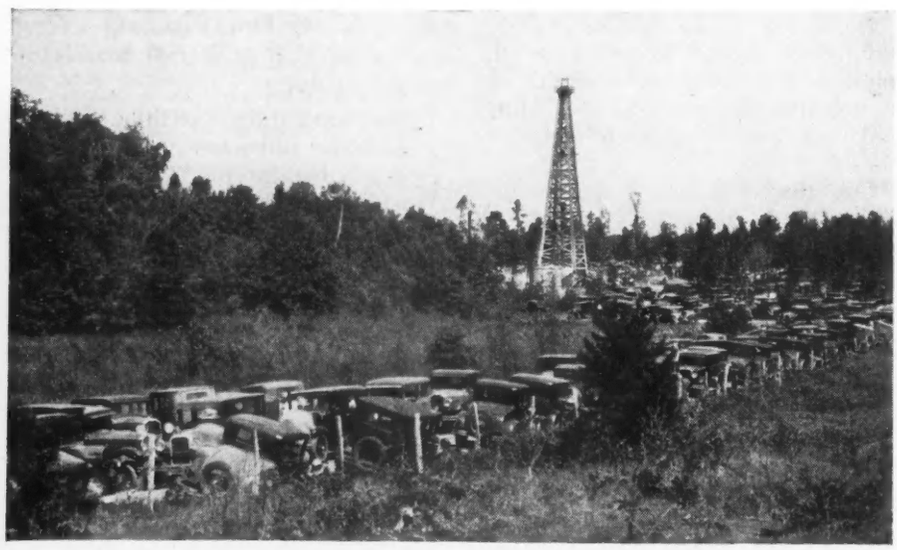
Following the Bradford discovery, which many experienced oilmen thought had lucked into a freak pocket of oil, Crim redoubled his efforts to obtain a test for Kilgore.

Despite the fact that two months previously the land he had in mind was checked off as barren of oil following seismograph operations, the Kilgore merchant finally found a taker, Ed Bateman, former Marshall, Texas, newspaperman.

Bateman was given a lease on 1500 acres. Included in a circle he drew on the map were 847 acres owned by Mrs. Crim and her three sons, J. Malcolm, John T. and Liggett N. Crim. The remainder of the property in the circle was owned by S. S. and Ben Laird, brothers, Roy H. Laird, and John and Ben Peterson, brothers.

The well was spudded Oct. 31, 1930. The driller was W. E. (Checkbook) Cain.

Bateman's financial resources hit bottom in December when drilling reached cap rock. He took his troubles to Crim and negotiated a loan of $86



Scene at Dad Joiner's Daisy Bradford 3, East Texas field discovery well.

with which a "hardhead bit" was purchased so the stubborn rock strata could be pierced. The bit eventually chewed through the rock, hit the Woodbine sand, and dumped into the lap of Bateman a cool $1,600,000—the price he received from Humble Oil & Refining Company for his 1500-acre lease.

That's when the sky became the limit in Kilgore.

Opportunities of this type were bound to lure individuals of a shady nature. They had it pretty easy for awhile, since the unincorporated town was policed only by a constable. But the picnic didn't last long. The boom was still in its infancy when 11 tough Texas Rangers were sent to Kilgore to take a hand. Their leader was rugged M. T. (Lone Wolf) Gonzaullas, who had already established a reputation in other Texas oil towns as a quick man with a gun.

One of the strangest sights in a town where strange sights were the rule rather than the exception was that of a motley group of "characters" marching to a church through ankle-deep mud one Monday morning. This was the result of a dragnet thrown out by the Rangers, encompassing crooked stock dealers, call girls, clip-joint habitues and a general run of bums and nondescripts of all categories.

To the humiliation of members of the congregation, the church served as a jail for more than three weeks—until a new jail could be erected.

Events such as these were duly chronicled in the Kilgore *Daily News* (now The Kilgore *News Herald*), a daily which only four days after the Crim discovery was publishing in a town that previously hadn't even been served by a weekly newspaper.

Expansion of the town was like the mushrooming of an atomic bomb cloud. Three months after Ed Bateman brought in his bonanza, 78 eating establishments had replaced the lone pre-boom cafe. Railroad receipts were reported to have exceeded $1 million in March, 1931. (They had totaled a modest $4000 in March of the preceding year.)

In the spring of 1931, Kilgore was incorporated by a vote of 102 to none. J. Malcolm Crim was elected mayor, and Roy H. Laird and Ben Laird were elected to serve with him on the city commission. A $30,000 city hall was built.

By this time, drilling in the East Texas field had become simply a matter of setting up a rig, punching a hole, completing the well and moving to another location.

Production became so abundant that the price of crude started looking for the bottom. Oil went down to a dime a barrel. Drinking water, meanwhile, cost more per gallon than oil did per barrel.

Boomtime scene in heart of Kilgore.

The flood tide of petroleum caused the Texas Railroad Commission to issue its first proration order for the East Texas field on April 3, 1931.

Indignation greeted the order in Kilgore as well as in other sections of the field. Almost immediately, operators started running hot oil far in excess of allowables.

Violence and willful flouting of proration orders produced a drastic counter measure. On Aug. 17, 1931, Governor Ross Sterling declared martial law in the East Texas field.

The National Guard was called out to enforce the governor's edict, and General Jacob Wolters proceeded to Kilgore, setting up his military headquarters in the new city hall. His troops pitched camp on the S. S. Laird farm near Laird Hill, more generally known by the colorful name of Pistol Hill.

Strife flared for the duration of martial law. Legal battles over the governor's right to call out the militia went all the way to the Supreme Court. Finally, on Dec. 12, 1932, the Supreme Court declared the governor's order invalid, and martial law came to an end five days later.

Laird Second Mayor

From December 17, 1932—Kilgore settled down to a busy, progressive life. It's second mayor was Roy H. Laird, one of the original commissioners and, like his predecessor, a man who was to become immensely wealthy from oil and other interests.

His driving ambition became that of converting his home town into one of the finest little cities in the world. With the aid of strong public backing, he succeeded admirably. He was a member of Kilgore's governing body from the date it came into being until his death on Dec. 19, 1950. He was completing his 18th year as mayor when he died at the age of 61.

During his tenure, more than 50 miles of streets were paved in the bustling "Oil Capital" which covers less than four square miles. Kilgore residents who boast that "even the alleys are paved," attend beautiful churches, some of which own oil-producing land. Their children attend classes in an excellent elementary school system or a high school rated superior last spring by a non-partisan group of visiting educators.

Kilgore College, a junior college founded in 1935, boasts an educational program which turns out students so well-trained that less than 1 percent of those who later attend senior colleges fail to master their courses.

The college pioneered a drilling practices class, sponsored by the American Association of Oil Well Drilling Contractors.

Seven football championships in 12 years of conference competition have been won by the Kilgore College Rangers, who never have finished below a tie for runnerup honors.

The Kilgore College Rangerettes, a fancy-prancing organization of precisionists, along with their tuneful sidekicks, the Ranger Band musicians, are in constant demand for appearances at extravaganzas throughout the nation.

Kilgore boasts a handsome public library which was the first in Texas—if not in the entire South—to be air conditioned. The city park nearby provides three well-lighted, concrete ten-

nis courts offering free access to all who wish to use them. Also at the city park are a municipally operated swimming pool and the usual picnicking facilities. A $150,000 community center building is planned for erection this year.

The City of Kilgore itself operates on a cash basis—and in the black. It now is whittling away at bonded indebtedness from a $500,000 street paving issue approved by the voters in 1946, a $650,000 hospital issue approved in 1948, $600,000 for sewage disposal facilities and sewer line extensions approved last year.

Hospital bonds voted in 1948 were issued for erection of a magnificent, 70-bed, colonial-type building dreamed of by the late Mayor Laird. With government financial assistance, he and City Commissioners E. C. Elder and E. C. Middlebrook completed their planning in time for construction to get under way a year and a half ago.

However, when it became apparent before construction was started that the hospital bonds and government aid combined would not provide enough funds, Mayor Laird and his wife promptly made a $100,000 contribution. Others followed.

Opening of the $1,368,000 edifice is scheduled in the near future.

Revenue is obtained by the city from the municipally owned water department. Property taxes are collected at the rate of $2.35 per $100 on holdings assessed at $21,175,000. Assessments are exceptionally low, since the market value of property in Kilgore is about $100 million or about five times the assessed values. Major portion of the city's revenue comes from oil property, a fact readily realized following one glimpse of the 1150 wells within the city limits.

But the citizens know that oil, expected to be abundant another 40 or 50 years under the field's excellent conservation program, will not last forever.

They support an energetic Chamber of Commerce, the principal objective of which is to attract industry to an attractive city—industry which will serve as a revenue-producing supplement to King Petroleum. An outstanding example of progress was the recent establishment of the Kilgore Ceramics Corporation, manufacturer of vitreous china bathroom fixtures.

One night in November, 1948, a mass meeting was held to discuss the advisability of creating the ceramics firm. About 50 persons attended. Before the meeting was over, nearly $70,000 had been pledged.

A $300,000 corporation, backed entirely with money from the home folks, was organized at once and a huge, well-constructed plant was erected.

Kilgore lies on the Missouri Pacific Railroad, has adequate bus service, and is served by State Highways 26, 31, 135 and 259.

Elder Airport at the northern edge of the city has facilities for handling planes up to and including those of the twin-engined DC-3 type.

Eight miles east is the expansive Gregg County Airport, a $3 million landing field which compares favorably with the best in the nation.

Since Kilgore is the hub of the great oil field in which more than 29,000 wells have been drilled, it isn't surprising that it was chosen as operational headquarters for the East Texas Salt Water Disposal Company, a $2 million corporation formed in 1942 with 18 major companies and 234 independent operators as subscribers.

Business in Kilgore, reflecting the city's prosperity, attracts new enterprises year after year. Among those recently established is a new bank, in which more than $1 million was deposited on opening day in mid-year, 1948.

Opened last summer was an up-to-the-minute drive-in theatre. Like the two other movie palaces in town, it is owned and operated on a partnership basis by East Texas Theatres, Inc., and L. N. Crim—the same fellow who, prior to the boom, showed moving pictures in Kilgore on Friday and Saturday nights as a sideline to his regular job as cashier at the bank.

One of the most obvious examples of Kilgore's enviable status is the amount of cash lying around. Deposits in the two banks and a savings and loan association totaled more than $16 million at the end of 1950.

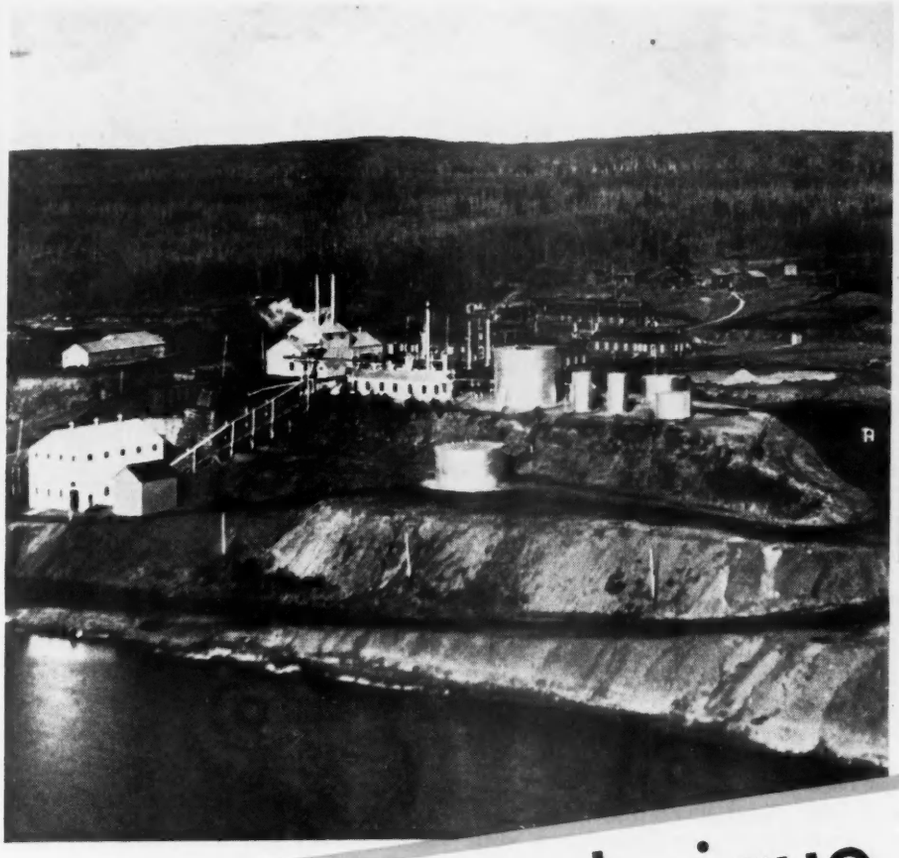
As for its air of progressiveness, this is characterized in a slogan coined by the alert executive vice president of the Chamber of Commerce, who circles the fourth and fifth letters of the city's name and calls it:

"Kilgore—the City with GO in it."

Kilgore today.

About the Author

JOSEPH P. ELLIS was born at El Dorado, Ark., in 1917, and was there during its boom days. He planned to become a petroleum engineer but after a year of pre-engineering work at El Dorado Junior College, he was lured away by newspaper work, serving as reporter and later city editor of the *El Dorado Evening Times*. He left to work with pipe line crews before enlisting in the Air Force in September, 1941. After four years which included cargo and transport flying in the North Atlantic area, he returned to civilian life and a job on the *Lion Oil News*, house organ of Lion Oil Company. He later worked in Lion's chemical plant before joining Charles K. Devall's *Kilgore News Herald* in 1947. He handles general news, features, and a daily front-page column about people.



CONSIDERING THE approach to a wartime economy in Canada and the U. S., the Athabaska tar sands again assume an important position. Believed to contain reserves of from 100 to 250 million barrels of oil, the tar sands have been more or less neglected in recent years because of their distance from ready markets and the cost of processing the oil. A pilot plant has been operating at the deposit, endeavoring to develop an inexpensive method of separating the oil from the sand.

Pilot plant at Bitumount, Canada, where Research Council of Alberta successfully processed the bituminous sands from the Athabaska district in Northern Alberta.
(Courtesy Government of Alberta)

New Technique Taps Athabaska *Tar Sands*

By DR. K. A. CLARK
Research Engineer, Research Council of Alberta

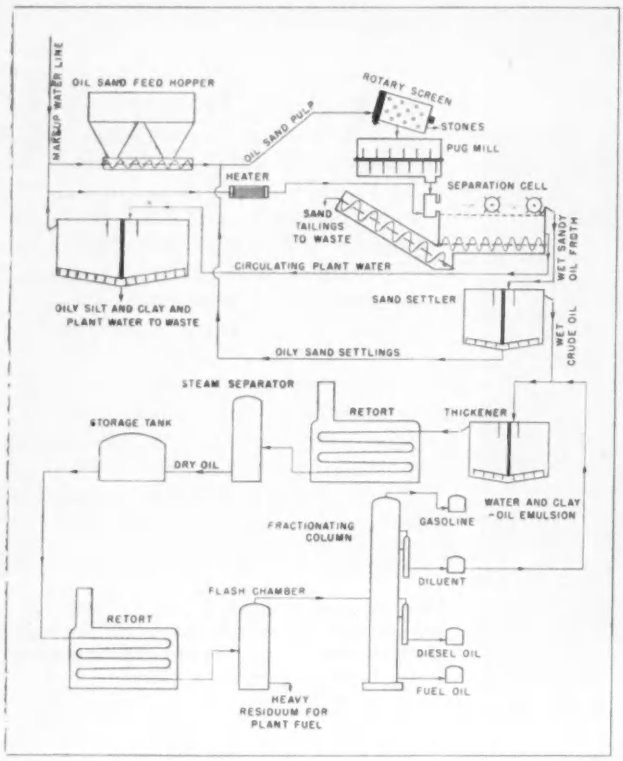
A PILOT plant operated by the Research Council of Alberta at Bitumount, Canada, apparently has solved the problem of how to extract the heavy oil locked within the vast deposits of the Athabaska tar sands located along the Athabaska River in Northern Alberta. During the summer and fall of 1949 the plant processed 500 tons of bituminous sands per day using a hot water process which was worked out by Research Council engineers and others after several years of experimentation. The unit performed with greater efficiency than laboratory tests indicated, recovering about 90 percent of the oil in the bituminous sand as a crude, wet product containing as little as 4 percent of mineral matter, mostly silt and clay, but with about 30 percent water content.

The dehydration unit dried the oil by evaporation after cutting the wet oil with a refinery distillate and settling out some water and mineral matter. It is believed that a better method for removing the water content can be evolved. Mechanically, the separation unit worked smoothly and engineers who observed the operation believe that it could have been operated indefinitely. Bituminous sand for the experiment was excavated from an open pit beside the plant by power shovel and delivered to a storage hopper by dump trucks.

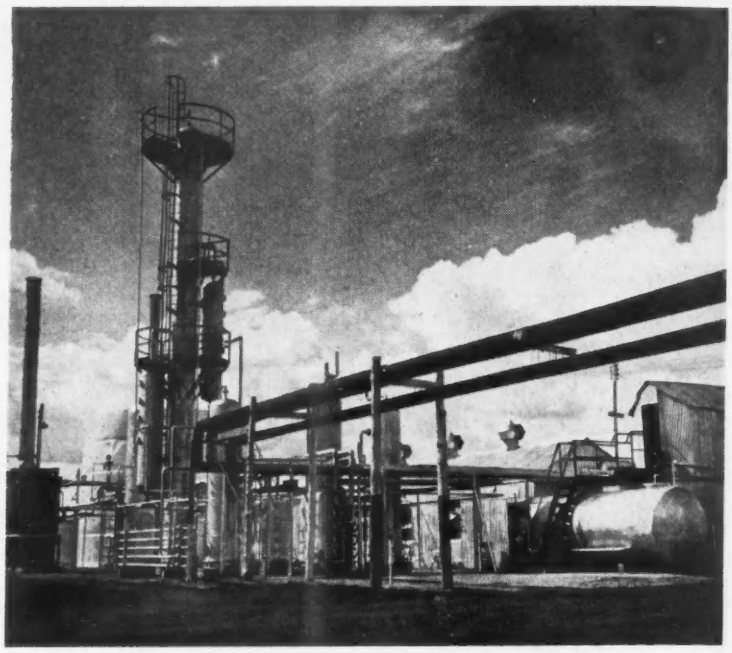
While the pilot plant operation indicates that extracting oil from the bituminous sands is technically feasible, it remains to be determined whether large scale bituminous sand development is a commercial possibility at present. This determination involves the choosing of a complete sequence of operations, from mining to the selling of products, the study of each step as applied to bituminous sand products and a cost and profit analysis of the whole set of operations. This forward step in attacking the bituminous sand problem is being made.

Bituminous Sand Deposits

The limits of the Athabaska bituminous sands have not yet been defined. There are 1500 square miles along 60 miles of the Athabaska River north of Ft. McMurray where bituminous sand is exposed in the valley walls where the river and its tributaries have cut deep enough to expose them under 100 feet, more or less, of unconsolidated sand and clay. However, there is evidence that the oil impregnation does not extend more than about 25 miles east of the Athabaska River. The western limits of impregna-



Schematic diagram of process used to extract oil from the sands.



Experimental refining and treating plant, Alberta Oil Sands Project, Bitumount, Alberta.

tion are not yet defined. The deposits extend far south of Ft. McMurray but they also increase in depth below the surface. A drill hole at Pelican Rapids, 50 miles west and 50 miles south of Ft. McMurray, reached the bituminous sands at 740 feet below an overburden of sandstone and shale.

The bituminous sand formation is from 100 to 200 feet thick, comprising of unconsolidated aggregate of fine quartz sand and varying amounts of clay material. It is of Lower Cretaceous age deposited on a floor of Middle Upper Devonian limestone. The asphaltic oil is —10 degrees gravity and contains about 5 percent sulfur. Highest oil content so far observed is 18 percent of oil by weight with an average 12-16 percent for good sand. There is also 2 to 3 percent water content, some of which wets the surface of the sand grains, and the balance being dispersed in the oil.

Laid down under deltaic conditions resulting in lenses and cross-bedding, the bituminous sand is characterized by a lack of uniformity passing in both the vertical and horizontal planes into clayey phases poorly impregnated with oil. While some areas are entirely impregnated throughout the section, it is usual for saturation to be erratic, being found either at the top, the middle or the bottom of the formation. Some stones occur in the formation, but not many. There is a persistent ledge of hard sandstone near the top of the formation. Thin partings of friable sandstone are scattered through the beds and round concretions of sand cemented with pyrite or kidney-shaped masses of indurated clay occur in some localities.

The Athabaska bituminous sands are not to be confused with oil shales as they contain crude petroleum, although of heavy grade, which can be dissolved from the sand with benzine. The heavy oil can be refined under conventional processes.

Current development practices involve excavating the bituminous sand and passing it through some form of an extraction plant. This is feasible only for high grade sand under fairly light overburden and only a small fraction of the deposits may be so classified. Sand occurring under such conditions is rich in oil. For instance, a square mile on the west bank of the Athabaska River between Mildred and Ruth Lakes has been cored by the Federal Bureau of Mines and showed an average overburden of 58 feet and bituminous sand of good grade for an average depth of 156 feet, containing an average oil content of 13.5 percent by weight. Reserves under this square mile are estimated at 285 million barrels of oil. There are five contiguous square miles that are almost as good and several other known areas that have not been drilled or sampled are probably as favorable as the Mildred-Ruth Lake area.

Hot Water Separation Process

Three general methods are available to extract oil from the bituminous sands: (1) destructive distillation; (2) solvents, and (3) hot water. The last method has received most attention and has been studied by the Research Council of Alberta for many years. The National Research Council at Ottawa is investigating the destructive distillation process but very little work has been done on solvent extraction.

The Athabaska bituminous sand responds readily to the hot water treatment but, unless the process is applied with care, the oil recovered is a very sandy product. The bituminous sand must be heated and pulped with not more water than can be absorbed by the pulp with no excess water present. When flooding the pulp with hot water to release and float the oil, aeration must be kept at a minimum.

When the sand is heated with water and mixed into a mortar-like pulp, the oil separates from the sand and disperses into small, variable-sized flecks that lie among the sand grains. The clayey material in the sand is closely associated with this oil dispersion. The oil flecks carry clay and the smaller are more heavily laden. The greater the content of clayey material in the sand the greater the proportion of the oil that disperses as very small flecks.

Oil in the pulp is collected by flooding the pulp with hot water, the larger oil flecks associating readily with air and water vapor and floating to the surface as a buoyant froth, while the small flecks remain dispersed

in the water. If slight aeration accompanies the flooding, very little sand is carried into the froth on the surface of the water, but if aeration is pronounced, the oil-air bubbles carry a great deal of sand to the surface and into the froth. If the flooding is properly carried out a froth with a mineral content of about 5 percent, mostly silt and clay, is obtained. Uncontrolled aeration results in sand contents of 25 percent or higher. There is 30 to 40 percent water content in the froth in either case.

The oil yield as primary froth depends on the content of clayey matter in the bituminous sand and this governs the proportion of the oil that disperses into very small oil flecks in the pulping operation and that fail to float as froth when the pulp is flooded. Some clay is essential, but too much depresses the yield. Laboratory work on sand from many locations throughout the deposit indicate a maximum yield of 85 percent. A "secondary" yield may be obtained by working the "tailings"—settling the sand out of the flooding water and putting the water, with fine mineral matter and oil flecks suspended in it, into a flotation cell. The oil froth formed contains more clay than the primary yield, but by controlling the aeration the mineral content can be kept down.

Pulping the bituminous sand with excess water, or in other words, making a watery pulp, causes a premature collection of coarse oil flecks into oil froth. The formation of the froth in the pulping stage results in the enmeshing of much sand.

The hot water used in flooding can be re-used after allowing it to settle so as to keep down the load of suspended matter and adding fresh make-up water. Suspended matter does not interfere with the flooding nor cause more than a minor increase in the mineral content of the oil froth.

In 1945 the government of Alberta decided to construct a pilot plant to determine the feasibility of extracting the oil from the bituminous sands and located the plant on a lease originally held by the International Bitumen Company, Bitumount, the assets of which had been acquired by Oil Sands Limited. Plenty of sand under light overburden, and facilities such as clearings, buildings, wharf and machinery, made the site advantageous. The plant, with a designed capacity of 500 tons of bituminous sand daily, was completed in the spring of 1949.

The plant flow sheet is shown in the accompanying diagram. The hopper holds 400 tons of sand, ample to feed the plant for two 8-hour shifts. Perforated high pressure steam pipes pass horizontally through the hopper bottoms a few feet above the steam-jacketed screw conveyor. The sand is mixed and heated to a smooth, mortar-like pulp as it moves forward through the conveyor, rotary screen and pug mill to the separation cell.

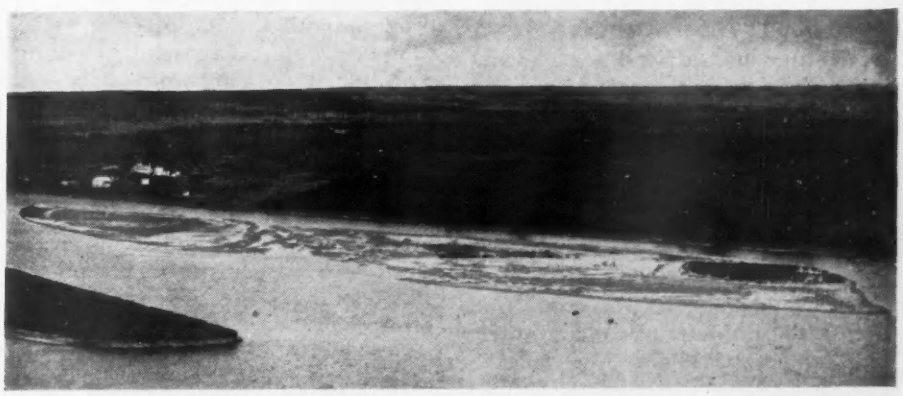
The hot plant water circulates through the separation cell and plant water settler, the water being held at a constant level in the separation cell and the overflow pumped to the settler. The silt, clay and fine oil flecks suspended in the plant water coagulate and settle readily. The underflow from the settler goes to waste, and the overflow is pumped through a heater back to the separation cell, where it enters through a comparatively small box in three streams arranged to create turbulence but with slight air entrainment. The bituminous sand pulp falls into this turbulent hot water where it disintegrates and is swept into the separation cell, the larger oil flecks floating to the surface as an oil froth that is skimmed off by a revolving paddle at the discharge end of the cell, while the sand sinks and is removed by screw conveyors. Fine mineral matter and very small oil flecks remain suspended in the plant water from which most of it settles in the plant water settler. Temperature, water levels and make-up water are controlled automatically.

The oil froth flows through a sand settler where the underflow of sandy oil is pumped back to the pug mill, although after operation it was discovered that this settler actually has no worthwhile function to perform. In operating the pilot plant it was found that there was very little sand in the oil froth and its mineral content consisted almost entirely of silt and clay. The overflow oil is pumped to the dehydrating unit.

In operating the dehydrating unit a scheme worked out by Abasand Oil Limited was used whereby the wet oil from the separation plant was mixed with a diluent, but much of the water was removed by evaporation instead of by settling. The hot, wet oil, containing about 30 percent water, was cut with about one-third its volume of diluent and passed through a settling tank. Some sand and coarse silt mixed with oil, free water and a gelatinous emulsion of droplets of water surrounded by oil films, settled and were discharged to waste. The settled overflow oil still contained 15 percent water and was pumped through a pipe heater where the water was converted to steam and discharged at 350° F. into a steam separator. Practically dry oil went to storage.

The refinery was a simple topping plant. It recovered the diluent from the diluted crude oil and made some new distillate from the bituminous sand oil. All the side streams from the fractionating tower were run to the diluent storage tank. The tower and flash chamber bottoms were combined and were used as fuel in the power plant.

The performance of the separation unit was the matter of real interest in the plant. The dehydration unit and refinery were incidental necessities. Some method of getting a dry fuel for the power plant was required to produce power and heat for the separation process. Cutting the wet, separated oil with a distillate was the only sure way known for dealing with the water when the plant was designed. Direct drying of the wet oil was not feasible because of its extreme foaming characteristics and because of the insulating effect of mineral matter which deposits on heating surfaces. It is unlikely that a dehydration unit and refinery unit like those of the pilot plant will appear in a commercial plant when one is designed.



Aerial view of Alberta Oil Sand Project, on the bank of the Athabaska River, at Bitumount, Alberta. Sand-bar in foreground interfered with water system, contributing to a shutdown for the winter season of 1949-50.

The separation plant performed well. There was no trouble at all feeding bituminous sand from the storage hopper. There was surprisingly little wear on the flights of the screw conveyors and the water-seal bearings kept grit from entering them. The primary yield of oil as oil froth was 90 percent of the oil in the bituminous sand feed. This was better than anticipated from laboratory studies. Secondary recovery of oil from the plant water settler underflow would raise the total oil recovery to 95 percent. With secondary recovery a total yield of 90 percent or better could probably be maintained even with a clayey bituminous sand feed.

The dehydration unit performed its function, but not too well. Too much oil was lost with the underflow from the settler. No way to treat this gelatinous emulsion of water, oil and mineral matter for recovery of oil, has been found. It would have been better to have evaporated the water directly out of the crude wet oil. An effective anti-foam reagent is now available to make this operation feasible.

The refinery recovered the diluent and provided fuel oil. The stock of diluent increased. Most of the bituminous sand oil went into the fuel oil, which accumulated rapidly.

Further Studies

The general result of the operation was to demonstrate that there was no technical obstacle to recovering oil from the bituminous sand by the hot water process. The plant was shut down at the end of September, 1949, since it was not designed for winter operation.

A small crew has been kept at Bitumount to make observations regarding the mining and preparation of a bituminous sand feed in cold weather. Further operation of the plant is desirable and probably will be carried out. But there is another study that should be undertaken and completed before a second season of plant operation is planned.

The time has arrived for viewing the whole picture of bituminous sand development and of determining whether it fits into the scheme of things for the near future or whether it belongs much farther down the road. There would appear to be no reason why a complete sequence of known operations cannot be chosen which would span the whole job from mining the bituminous sand to offering commercial oils to the market. The yields of products in the various operations and their characteristics are either known now or can be determined by direct test. Costs for the various operations and the value of the final products should be amenable to reasonably close estimate. The relationship that would emerge between costs and values would reveal whether bituminous sand development belongs to this generation or the next. Also, the study would point out the technical problems in need of further study and the order of their priority. This study is now under way.

One of the problems confronting development of the Athabaska tar sands is transportation, and this must necessarily be provided by pipe line facilities, although the product to be transported will not be the heavy crude primarily extracted from the sands but a product that could be more easily handled. The primary recovery cracks readily in destructive distillation to an 80 volume percent yield of 25-gravity distillate, 17 percent coke, and some gas. If this means of obtaining a more viscous product which could move along a pipe line were used, the sequence of operations would include (1) mining the bituminous sands; (2) recovery of oil from the bituminous sands; and (3) coking of the recovered oil. The plant would operate on the coke and gas and would deliver the distillate by pipe line.

Information on pipe line transportation costs will be augmented after the facts are available in connection with the Edmonton-Great Lakes pipe line project now under construction.

Because of the high sulfur content of the crude recovered from the tar sands, the refining process will present some problems, but the oil industry is well equipped to overcome them. Trial and error tests will determine the best methods for refining this type oil.

An over-all study of the bituminous sand development possibilities will give consideration to other than the hot water method of extracting the oil. The Bureau of Mines at Ottawa, for instance, has made important progress with the use of cold, rather than hot, water as a washing medium. This line of work grew out of the high heat requirements of the Abasand Oil plant which the federal government operated experimentally. The scheme is to add the diluent to the bituminous sand in the pulping stage. Since diluted crude oil is fluid, cold water suffices to wash it out of the pulp in the flooding stage. The wet diluted crude has to be dried before further processing.

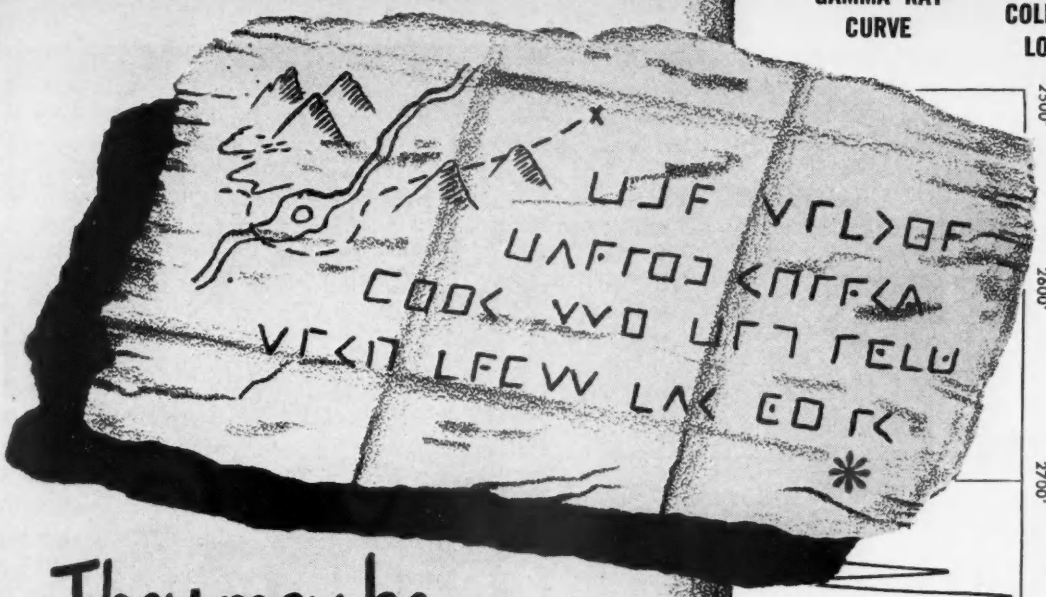
A quite different approach to the problem is being followed at the National Research Council at Ottawa. There the fluidized solids technique is being used to make the retorting of bituminous sand a continuous process. A feed of bituminous sand is dropped into a hot, fluidized sand bed. The overflow of coked sand is fluidized with hot air in a second bed where the coke burns and raises the sand temperature. The reheated sand goes to the first bed. By this means a cracked distillate is obtained directly from the bituminous sand and the process is maintained by the coke and gas produced. The process has not been completely explored. Results so far are very interesting.

Production Without Mining

In conclusion, consideration should be given a problem that must be solved before the vast storehouse of oil in the bituminous sands becomes of full significance. As has been indicated, great quantities of oil can be extracted from the locations over the deposit where good grade bituminous sand under light overburden can be reached by open-pit mining. But these quantities are small compared to the total oil in the deposit. Some means other than strip mining must be found for getting the oil from beds which are deeply buried by overburden, by lean bituminous sand, or by both, before the main body of oil in the bituminous sand deposit can be considered as accessible.

The problem has received considerable thought and some study, but little progress has been made. The possibility of a water drive was examined, but facts are against it. The sand aggregate of good grade bituminous sand is very permeable. In flow cells in the laboratory, water displaces oil effectively at temperatures of 150° F. or greater. But, unfortunately, the formation temperature of the deposit is about 36° F. There is no obvious way of heating the beds in place. In that connection, bituminous sand is a very poor conductor of heat. Its coefficient of thermal conductivity is about 0.0035 in centimeter-gram-second units. This fact alone was sufficient reason for the failure of two attempts that have been made to destructively distill oil out of the bituminous sand beds by heat applied down a borehole.

In all probability, bituminous sand development will commence with open-pit mining. Areas suitable for this procedure will supply operations on a grand scale for many years. In the meantime, rising prices for oil and accumulation of practical experience should open the way to extending the development into the much vaster store of oil in the main body of the bituminous sand deposit.



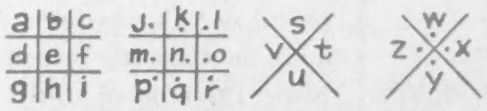
They may be Roadmaps to Riches!

The twin curves of a radioactivity well log are something like the treasure maps of romance . . . when interpreted, they may lead to buried wealth — if *they're accurate.*

Lane-Wells Radioactivity Well Logging gives you extremely accurate gamma ray and neutron curves for the excellent reason that the instruments are sensitive to even the smallest significant changes in the formations traversed. And extensive experience in every oil field has proved that the Lane-Wells curves are repeatable, and therefore dependable.

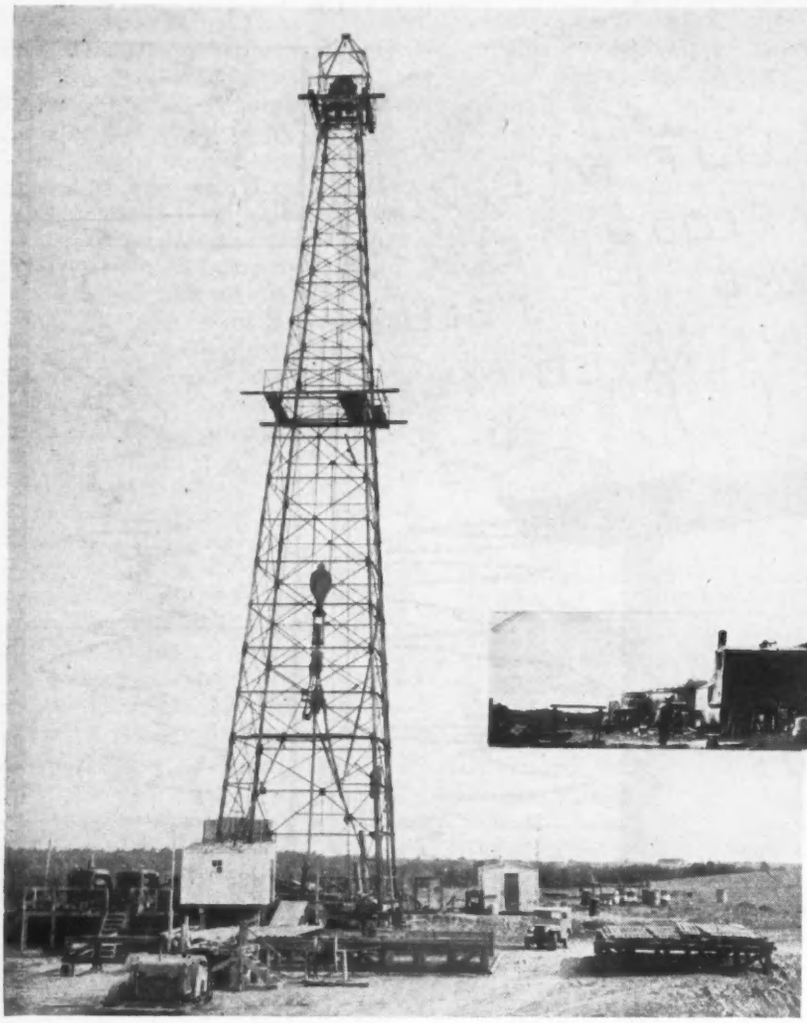
The experience gained in more than 30,000 Radioactivity Well Logs enables Lane-Wells men to give you expert aid, if requested, in interpreting your log — aid which is helpful particularly where local conditions cause unusual responses in the curves. This experience, coupled with the extreme accuracy and dependability of the log, is the reason why most experienced operators agree that, in either cased or open hole, you'll get the best results with

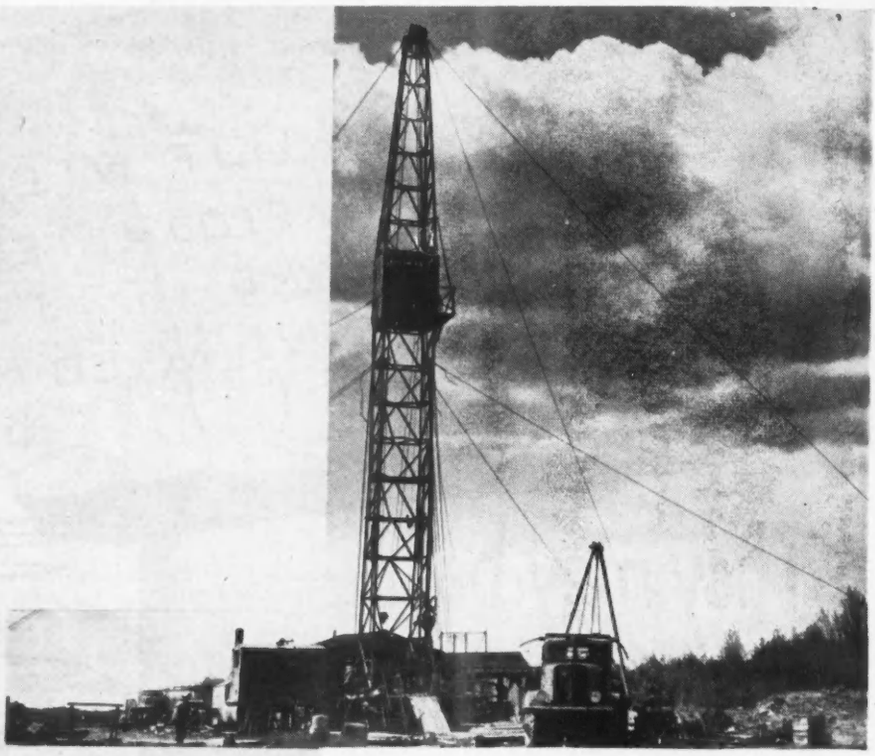
*This message is written in the once-popular "pig-pen" cipher, constructed like this:



General Offices, Export Office and Plant • 5610 So. Soto St. Los Angeles 58, California

Los Angeles • Houston • Oklahoma City
Lane-Wells Canadian Co. in Canada
Petro-Tech Service Co. in Venezuela





Left. Old driller in Leduc. When drilling first started in Leduc big rigs were used.

Above. New driller in Leduc. Jackknife rigs are now being used.

Reservoir Engineering – Part 2

Leduc D-2 Zone Pool

By JAMES E. BAUGH

Petroleum Engineer, Sun Oil Company

THE Leduc field was discovered in February, 1947, by Imperial Oil Limited, with the completion of Imperial Leduc 1 as a commercial oil well in the Devonian D-2 zone formation. (The D-2 zone has recently been renamed the Nisku formation by the Association of Petroleum Geologists of Alberta.) Prior to this the majority of exploratory wells in Alberta had been in the Southern Plains area, with the Devonian considered a rather secondary possible producing horizon. Some Devonian success had been obtained in the Princess area of Southern Alberta, but the Leduc D-2 zone discovery created an active interest in the possibilities of the Devonian. This discovery was mainly responsible for the current extensive exploration in Central and Northern Alberta.

The D-2 zone pool in the Leduc field had been about 50 percent drilled out at the time of this writing. Approximately 175 producing wells had been completed.

Geology and Structure

The D-2 zone is a blanket type deposit of dolomite which occurs over a wide area of North and Central Alberta. (Figures 1 and 2.) Generally speaking, it is very uniform in thick-

SECOND IN A series of reservoir studies covering fthe Redwater, Leduc D-2 and D-3 pools in Alberta, Canada, this article discusses the Devonian D-2 limestone reef formation, which has proved to be a substantial producer in Canada's present oil boom. This series of articles appeared in the *Canadian Oil and Gas Industries* magazine.

ness, and averages about 150 feet. In most places the D-2 contains a large amount of coralline material and some geologists think it is of reef origin. The D-2 is capped by a silty horizon known as the red-beds or red shale about 30 feet in thickness. Underlying the D-2 is the green shale which varies in thickness from 100 to several hundred feet depending upon the presence or absence of a D-3 reef below it. Since the red shale cap rock is very dense and impervious, conditions for entrapment are excellent in areas where structural closure exists and where the D-2 zone is porous.

Structure in the D-2 zone has been caused by the influence of the D-3 zone reef below it. Figure 2 shows that the configuration of D-2 compares very closely with that of the D-3 zone reef contours. Thickening of the green shale between the two zones results in a lesser relief in the D-2 structure, but all features of the D-3 are reflected to some extent in the D-2.

Porosity occurs as both intergranular and vuggy with a small amount of fracturing. The occurrence of porosity is very streaky and lenticular, with zones of high porosity alternating with streaks of dense, tight dolomite and in some cases, silty streaks. To add further to the lack of continuous uniform porosity, is the presence of a large amount of anhydrite infilling the pore spaces, which in some cases practically eliminates both porosity and permeability.

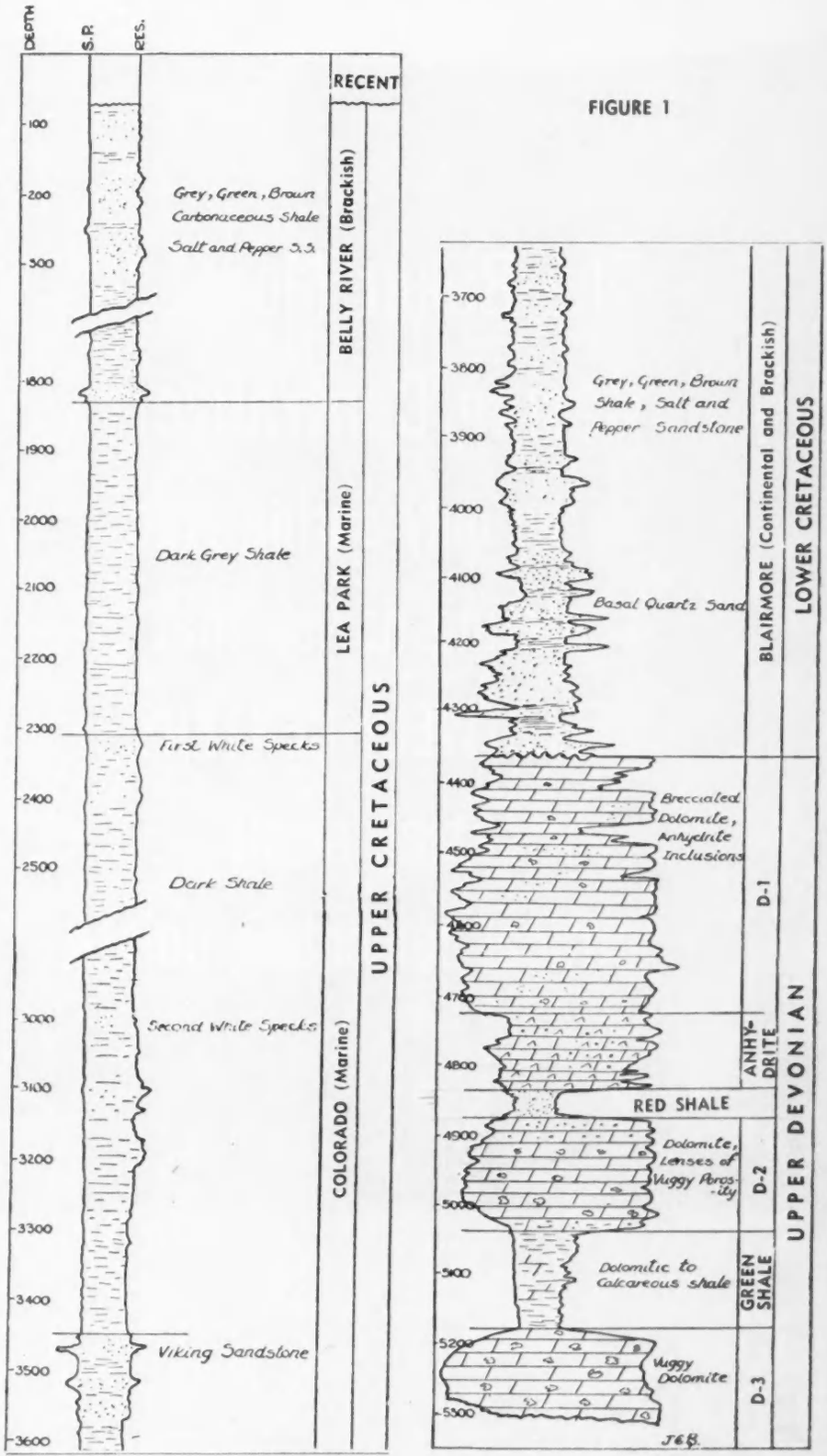
The occurrence of anhydrite infilling is at a maximum on the highest part of the structure. Despite the fact that this is the most desirable structural location, the area is non-productive due to the lack of porosity. The D-2 pool in the Leduc field may then be regarded as a combination structural and porosity barrier entrapment.

Fluid in Reservoir

As a result of the erratic nature and occurrence of porosity in the reservoir, the occurrence of fluid contained in the reservoir follows a similar pattern. The productive oil section varies from three feet to about 90 feet from poor wells to good wells. The structurally low wells usually encounter salt water but there is no uniform, level water table. Water may occur as high as 2775 feet subsea, but some wells have obtained water-free oil production below 2850 feet subsea. Thin local gas caps have been found in some wells in the central part of the field but it is generally considered that no over-all gas cap exists in the reservoir.

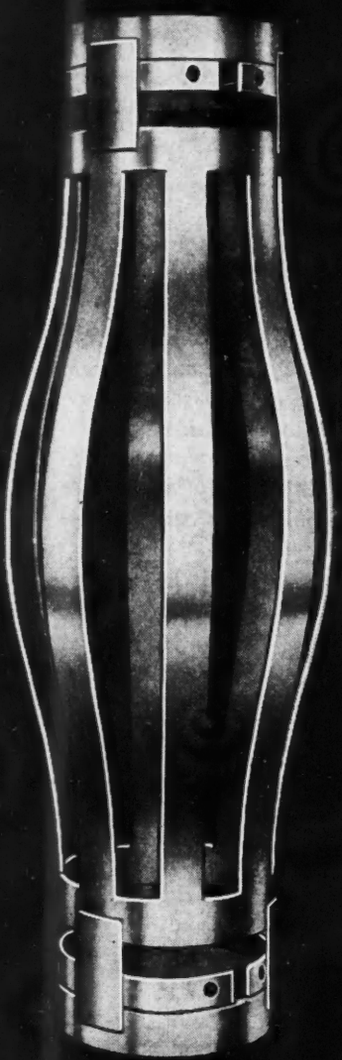
Outside the limits of the oil reservoir, the D-2 zone retains most of the above characteristics. The amount of anhydrite has been noted to increase in a southerly direction and to the north, the zone has been found to be predominantly silty. The zone wedges out about 50 miles to the west of the Leduc field. Where porous D-2 has been contacted beyond the limits of the Leduc field, it has been found to

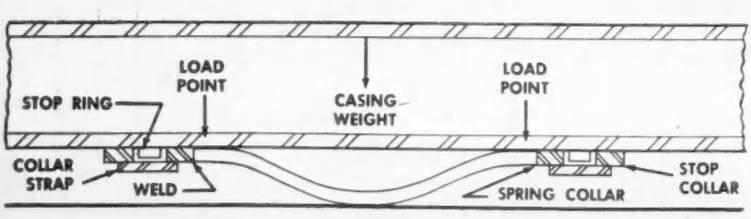
FIGURE 1



Use the only centralizer that

The Baker Model "G" Casing Centralizer is the only spring-type centering device that EFFECTIVELY CENTERS your casing at all critical cementing points.





THIS SIMPLE ILLUSTRATION REVEALS THE IDEAL IN SPRING DESIGN AND MOUNTING, WHICH IS FOUND ONLY IN THE BAKER MODEL "G" CASING CENTRALIZER. Note how the load point is imposed directly upon the casing; and how the properly "contoured" spring is free to move along the smooth surface of the casing as the spring deflects under compression. There is no chance for concentration of stress to cause a permanent set, or to result in breaking the spring. Note that ample clearance exists between Stop Rings and Spring Collars to accommodate the increased length of the springs which results from their complete flattening as the centralizer passes dog-legs or tight spots in the hole.

t really centers your casing!

The scientific design of the Baker Model "G" Casing Centralizer (Product No. 910-G) enables the springs to yield REALLY EFFECTIVE CENTERING FORCE, even after repeated flattening from passing through "dog legs" and hole restrictions. Exhaustive tests prove that these springs take practically no permanent set—far less than any other centralizer.

The Model "G" Centralizer is available in all sizes, in three size ranges, thus providing a combination of size and bowed-height of springs "tailor-made" to meet your specific requirement, with maximum efficiency.

There is a specific size of the Baker Model "G" Casing Centralizer to meet any combination of casing sizes in relation to the size of the open hole, without compromise or adjustment. The result is EFFECTIVE LANDED CENTERING FORCE far exceeding that obtainable from any other spring-type centralizer.

The springs of the Baker Model "G" Casing Centralizer are scientifically designed to provide additional assurance of cementing success. The vertically mounted springs act like runners on a sled and do not cut into mud or soft formations like springs which are spirally mounted. Springs on the Model "G" Centralizer do not scrape off the mud cake as they are lowered down the hole, eventually building up a bridge ahead of the centralizer; they do not remove or loosen the mud cake opposite a low-pressure zone so that the cement slurry (under pressure) breaks down such formation and channels out into the low-pressure zone. The springs on the Model "G" Centralizer readily pass through a key-seated section of the hole, with no danger of catching under the shell (or key-seat) and breaking off—an ever-present danger with spirally mounted springs.

Operators who know all the facts about the Baker Model "G" Casing Centralizer specify and run them exclusively. They know from experience that they are buying the greatest possible centering force for their casing, to be applied *exactly where they want it in the hole.* Isn't that what you too expect and really want from a casing centralizer?

BAKER OIL TOOLS, INC.

HOUSTON • LOS ANGELES • NEW YORK

GET EFFECTIVE LANDED CENTERING FORCE WITH BAKER CASING CENTRALIZERS

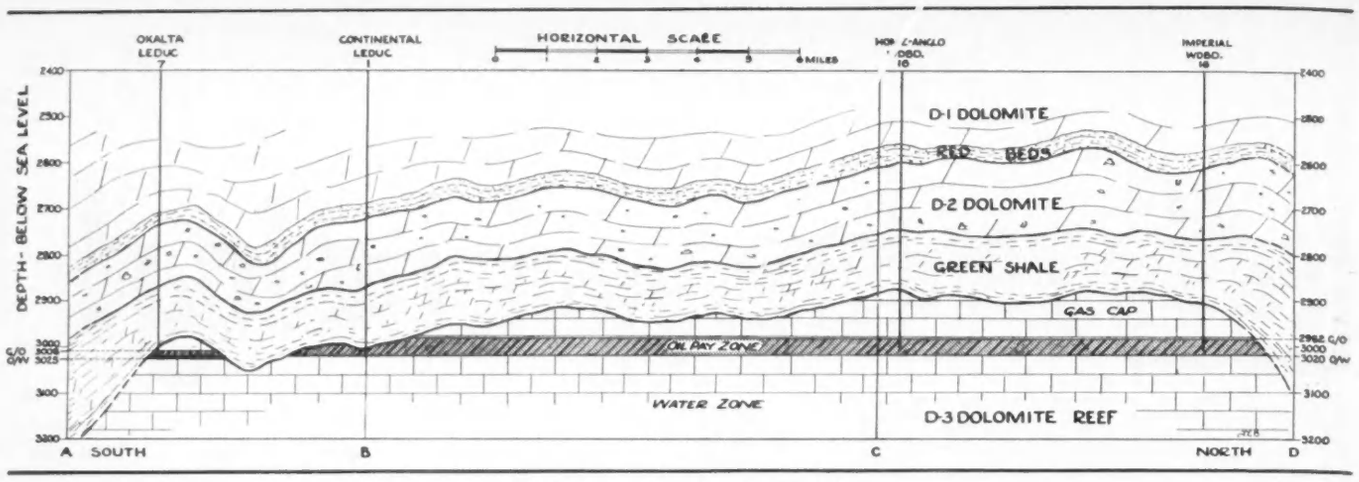


FIGURE 2. Cross-section, Leduc field.

be water bearing. Since the discovery of the Leduc D-2 zone pool, commercial production from this horizon has been obtained in the Bon Accord, Excelsior, Stettler and Normandville areas.

Reservoir Rock Properties

As mentioned above, the porosity in the Leduc D-2 reservoir occurs in many different ways and degrees. One of the best wells in the pool cored 90 feet of excellent porosity. The average porosity of this 90 feet was about 17 percent. On the other extreme, some wells have an average porosity from core analysis of about 2-3 percent, with production being obtained from a very few feet of section with a permeability above 10 millidarcys. With this variation in reservoir rock characteristics, it is very difficult to discuss average properties of the reservoir. However, it appears that the average D-2 well in the Leduc field has about 25-30 feet of effective producing section with a porosity of 9 percent. Permeability is generally in the range of 0-100 millidarcys but occasional sections of vuggy or fracture porosity might have a permeability above the 100 millidarcy limit. Reported connate water content of the reservoir rock is 15 percent. Quantitative data on porosity and permeability are included in the table of reservoir data.

Reservoir Fluid Properties

Upon discovery, the Leduc D-2 zone reservoir contained saturated crude at a pressure of 1760 pounds per square inch gauge and a bottom hole temperature of 149° F. As previously mentioned, there is no gas cap above the oil section, except in a few structurally high wells and those are small local highs. The oil is 39 gravity and is considered fairly sweet. There is some variation in sulfur content of the crude and solution gas throughout the reservoir, but generally speaking it is quite low.

Solution gas oil ratio as measured at original conditions of temperature and pressure was 689 cubic feet per barrel of residual oil. Shrinkage factor from original to stock tank conditions was 0.72.

Reservoir Data

	Value
GENERAL DATA	
Depth of wells (average) ft.	5,000
Ground elevation above sea level (average), ft.	2,300
Structural relief of productive area, ft.	300
Thickness of zone (average), ft.	150
Effective thickness of porosity (average), ft.	30
RESERVOIR FLUID PROPERTIES	
Reservoir pressure (original), psig.	1,760
Reservoir temperature, °F.	149
Solution gas-oil ratio, original (reservoir fluid basis*), SCF/bbl.	490
Solution gas-oil ratio, original (residual oil basis*), SCF/bbl.	689
Shrinkage factor, virgin conditions to 14.4 psi. and 60° F. vol./vol.	0.72
Gravity of residual oil, A.P.I.	39.0
Compressibility of saturated reservoir fluid at 149° F., per cent per 1,000 psi.	1.120
Thermal expansion of saturated reservoir fluid (80° F.-149° F.), per cent per °F.	0.057
RESERVOIR ROCK PROPERTIES	
Porosity of porous zone (average), per cent	9
Connate water content, per cent of pore space (average), per cent	15
Range of permeability, md.	0-100
VOLUMETRIC ESTIMATES	
Productive area (estimated), acres	18,000
Volume of oil in place per acre foot (estimated), bbl.	430
Volume of oil in place per acre (estimated), bbl.	12,900
Estimated recoverable oil, bbl/acre ft.	85

Note: Bottom hole pressure datum 2645 feet subsea.
*Based on differential liberation.

Production Characteristics

Individual well production characteristics vary considerably as a result of the wide differences in reservoir rock properties from one location to the next. Some wells exhibit excellent flowing characteristics, while others require pumping upon completion. There were approximately 20 D-2 zone wells on pump at the time of this preparation. Production rates are controlled by The Petroleum and Natural Gas Conservation Board. The current allowable is 70 barrels per day per well.

Bottom hole pressures have declined by various amounts in D-2 wells. The wells which have the longest production history have the lowest pressures. Figure 3 is a typical D-2 zone well pressure decline curve for one of the oldest wells in the pool. Also shown on the graph is cumulative monthly production and monthly producing gas oil ratio for the same well. The productivity indices of the wells are generally very low—in the range of 0.5-3.0 barrels per day per pound drop. This is due, of course, to the low average permeability of the reservoir rock.

Upon closing in a producing well, the bottom-hole pressure builds up over a long period of time. In most cases, this buildup time from flowing to equilibrium pressure, is several days and may be as long as two weeks.

Since the porosity and permeability are not uniform or continuous in the reservoir, it is very unlikely that a water drive will be established. Water occurs only in a small percentage of

the producing wells. Solution gas drive is the only expected recovery mechanism. In this regard, ultimate recovery of the oil in place is expected to be about 20 percent.

Figure 4 is a graph indicating the production history of the pool. The field average gas oil ratio has increased over the past life of the field. This is typical of a solution gas drive pool. Some individual wells have gas oil ratios above 2000 cubic feet per barrel, but the majority of the wells produce about 700 cubic feet per barrel.

The productive area of the Leduc D-2 zone pool has been estimated to be about 18,000 acres. Since there is a wide variation in the volume of oil in place per acre from one section of the reservoir to another, the recovery from these tracts will also vary, a porosity-area reserve estimate based upon field average conditions is not too satisfactory. However, a calculation of this nature indicates a field average recovery of about 85 barrels per acre foot, and a field total recoverable reserve of about 47 million barrels of stock tank oil. Individual wells will probably obtain recoveries varying from 25 to 175 barrels per acre foot, with corresponding variation in total recovery per well. When the field is completely drilled out, it may develop that the average estimated above is considerably in error. There are a large number of well locations undrilled in the southwestern part of Township 50, Range 26, west of the fourth meridian and in the Woodbend sector, which may or may not be productive. The above acreage estimate has included these locations.

General Completion Practices

On locations which are both potential D-2 and D-3 acreage, the D-3 zone is normally drilled out first and formation tests made on the D-2 in these wells. If D-2 production is indicated, a twin well is drilled about 100 feet from the D-3 well. Open hole completions are favored, with 5½- or 7-inch casing being set in the red shale after drilling out the D-2. Since there is no definite water table, most wells are completed at a total depth near the base of the section. Generally, the productive section is near the midpoint of the D-2 zone and drilling is finished at a point where no more porosity is encountered. On flank locations, where salt water may be encountered, drilling is stopped somewhat higher in the section.

Acidization is carried out by most operating companies with noticeable increase in Productivity Index and improvement in flowing characteristics. Acid treatments vary from small wash shots of 100 gallons to 2000 gallons of 15 percent hydrochloric acid.

Drilling problems are generally small in Leduc D-2 zone wells. Some instances of lost circulation have occurred, but these have been few in number, since the permeability of the reservoir is low. Lost circulation has been limited to wells in which the permeability has been increased by severe fracturing. Average well completion time is about 40 days.

BIBLIOGRAPHY

"Leduc Oil Field, Alberta, A Devonian Coral Reef Discovery," April, 1949. D. B. Layer, A.A.P.G., Vol. 33.

"Leduc Oil Field, Alberta, Canada." March, 1949. Theo. A. Link, Bul. Geol. Soc. Am., Vol. 60.

"Leduc D-3 Zone Pool, Alberta." July, 1950. J. E. Baugh, Canadian Oil and Gas Industries, Gardenvale, Quebec.

This article first appearing in the September, 1950, "Canadian Oil and Gas Industries" has had pertinent figures brought up to date.

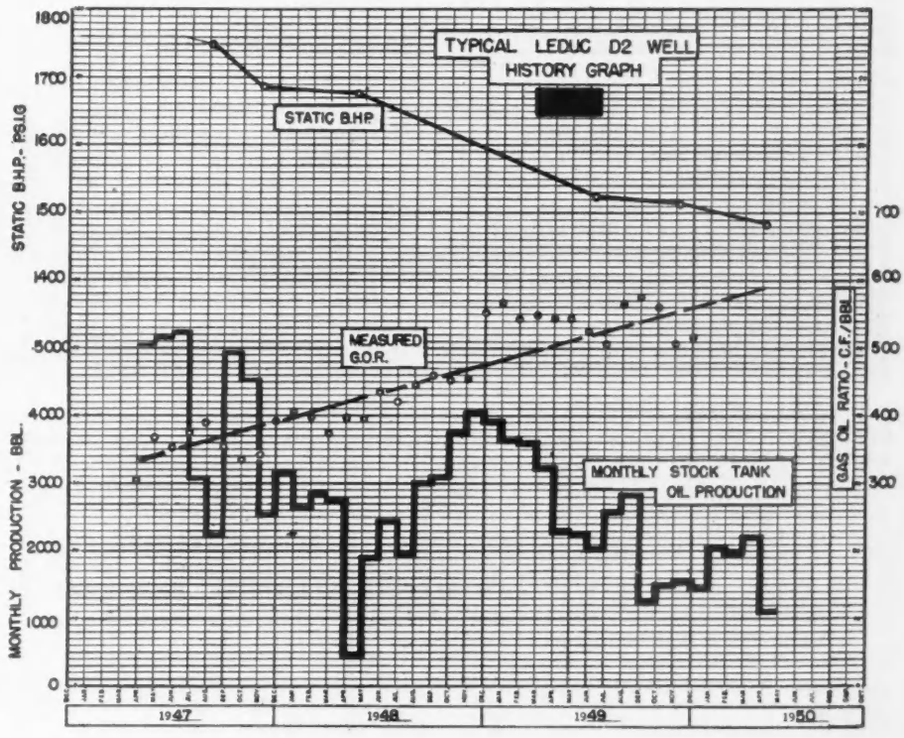


FIGURE 3

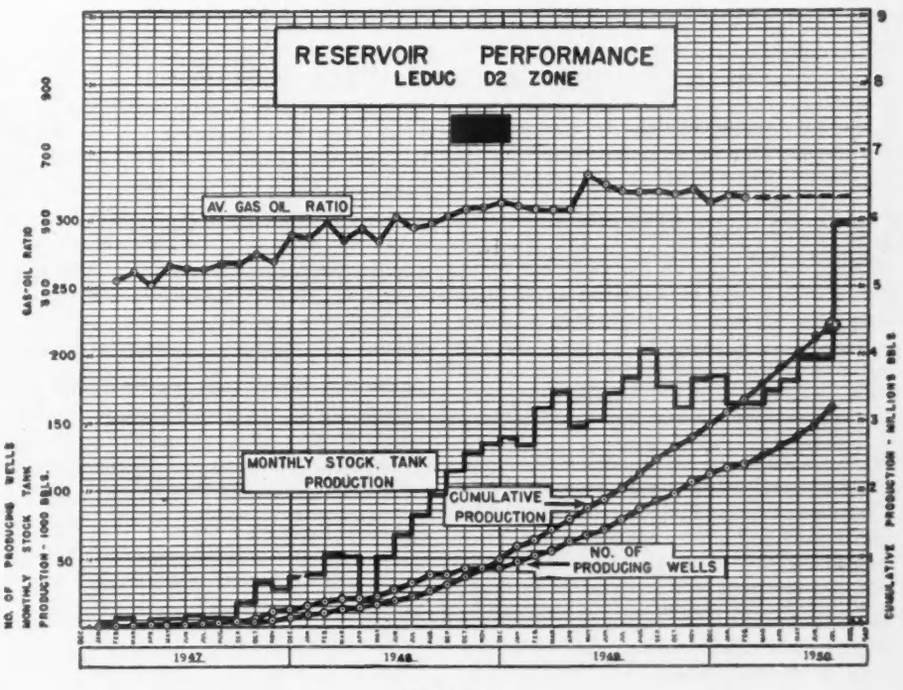
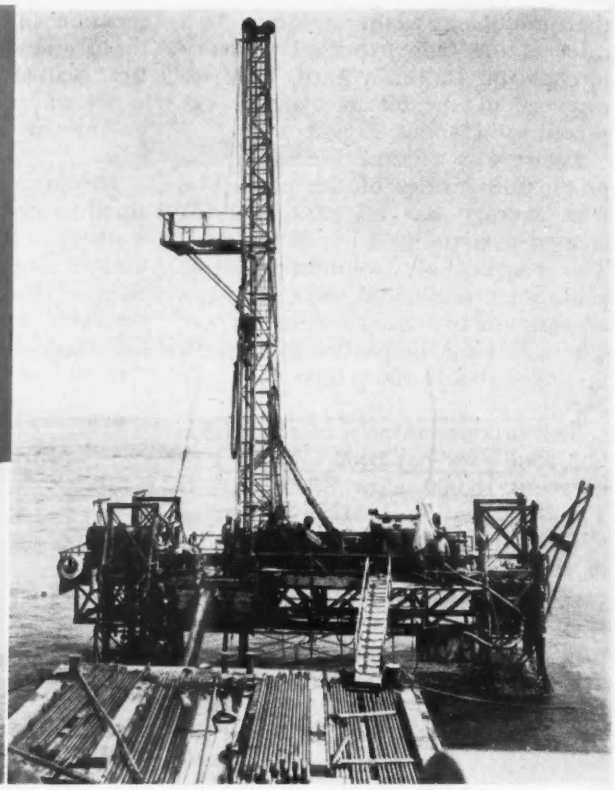


FIGURE 4

Aramco Spuds First *Offshore Test*

The two-barge structure drill unit being operated by the Arabian American Oil Company in the Persian Gulf. On the right is the barge containing living quarters and on the left, from which is suspended the structure drill itself, are working and operating quarters.



The rig operates on two 40-foot U-shaped legs which are lowered onto the bottom to provide a firm foundation. A combination of ballast tanks and tide are used to raise the legs when moving the rig to a new location.

By HENRY OZANNE, Eastern District Editor

ARABIAN American Oil Company spudded in its first offshore test in the Persian Gulf the latter part of January. The well is being drilled 20 miles south of Ras el Mishaab and three miles offshore, near the northern limit of Aramco's concession area. Water depth at the location is about 20 feet, over an irregular sea bottom, on a structure that has been tested with about a dozen holes in the area.

The site was chosen after a two-year survey but also on the basis of geological work that dates as far back as 1938 when a land seismograph crew found first evidence of a possible offshore structure. Following World War II, an expanded geophysical program was carried on by Aramco, and during the 1947-1948 field season a gravity meter party reported indications of the offshore structure. In the last two years marine structure drill and marine seismograph parties explored the area in detail and confirmed the earlier findings. Test holes have been sunk to 1200 feet, and one had a flow of oil, apparently from the top of the formation known locally as the Safamiya, which also gives its name to the well, Safamiya 1. Seven producing formations have been determined in the region. Practically all Saudi Arabian production comes from lime.

The structure holes were drilled from self-propelled barges with a novel drilling rig suspended from the end of the barge. Two 40-feet long U-shaped legs were lowered to the bottom to provide a firm base for operations. When a test hole was completed, a combination of ballast tanks and tide was used to lift the legs so the barge could be moved to the next location.

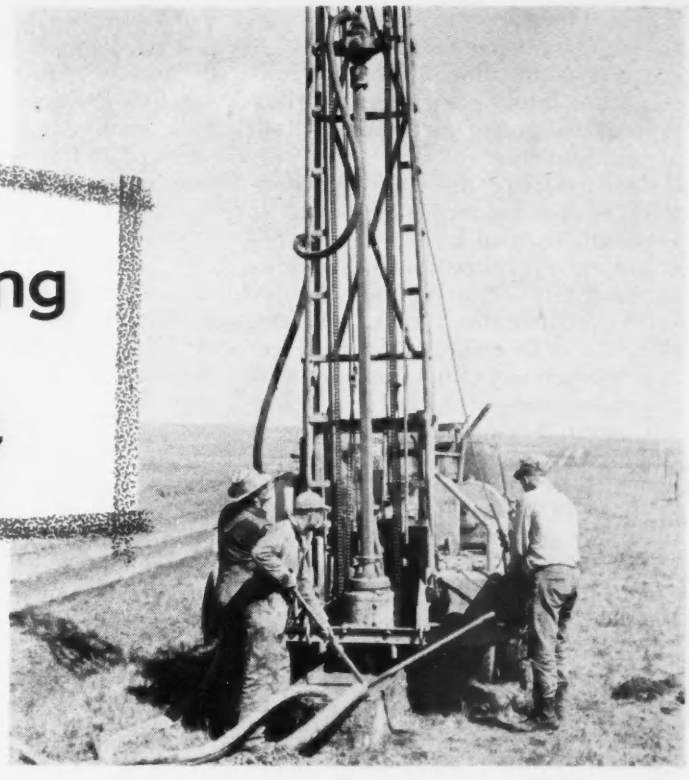
Drilling operations at Safamiya 1 are conducted from a multiple-level platform. A big problem of space was solved by putting equipment on four levels to provide vertical rather than horizontal expansion. The platform over-all is 55 by 143 feet. It contains a pipe platform 55 by 60 feet, a main deck 44 by 83 feet, a derrick floor 64 by 42 feet, and a generator house and powerhouse level 24 by 30 feet.

To support the 500-ton rig, 125 steel H beams, 14 inches by 90 feet long, were shipped to the site and a pile driver drove them through 15 feet of mud and into five feet of hard rock. Four barges supplement the rig. One carries the 650 tons of drilling mud needed for circulation, another the cement, while a third, a utility barge, is loaded with fuel oil necessary for power. A fourth barge is used to haul away any oil found during testing. Four launches and three tugs complete the shipping requirements.

Drilling went on a 24-hour basis with 30 men on the job. Another 35 men handle the boats and assist with the barges, which are 30 by 110 feet each.

Working conditions are favorable, the water location being cooler in summertime than the land and slightly warmer in winter. The sea is not unduly rough at the location. The site is farther north than any yet drilled by Aramco except for a land test a number of years ago. Depths of around 8000 feet are anticipated to reach producing formations, although basement at the location is about 20,000 feet. About six submerged domes have been found in the Persian Gulf, all favorable for finding oil.

Shot Hole Drilling in Canada



By W. A. BURGGREN

President, Burggren Exploration and Drilling, Ltd.
Calgary, Alberta

THE amount of exploratory drilling far exceeds general beliefs, running into astronomical figures each month. For every seismic party in the field there are from two to four exploration rigs which will drill from 4000 to 12,000 feet of hole per month. The individual holes range in depth from 50 to several hundred feet.

In this surface drilling, all types of sedimentary deposits in all conditions of compaction and cementation are encountered, posing problems as varied or more so than in deep drilling. Also, besides these shot hole rigs, there are many corehole or structural hole drills operating to greater depths and having the problems of surface drilling plus problems peculiar to deeper drilling.

In considering statistics on the numbers of seismic parties in operation it should be remembered that there must be nearly twice as many small rigs operating to keep the seismic crews busy. For every reflection profile shot, there must be drilled one hole or more ranging in depth from 50 to several hundred feet.

Consider first the shot hole drilling. This is one of the fastest operations of the industry. It has to be. The equipment for shot hole drilling consists of a light rotary drill mounted on a truck with water truck in attendance. They go to work with an assignment of from 5 to 12 holes to be drilled each day. To drill these holes they must travel over difficult terrain in many cases, and the day's drilling may encompass several different drilling problems. They must meet and overcome them all. They may have to drive 25 miles or more to start their work. Ten holes means ten complete setups and tear-downs besides the moving of equipment between locations. The shooting crew follows these forerunners and depends upon their speed for the production of reflection records.

Core hole and structural hole work is one and the same thing in this period of oil development. The method at one time consisted of taking cores or samples of formations in each hole to depths ranging from 500 to 2000 feet. This has been eliminated due to the slowness and costliness of the process. Holes are now drilled to definite marking horizons in formations, and electric logs run in them. These electric logs give the picture of the formation drilled from the bottom of the hole to the top.

Definite markers can be picked on the log and correlated with equivalent markers on logs from other holes. By calculating the elevations of these markers for each hole and plotting them on maps, subsurface contour maps of the formations may be made. Thus, through the use of this speedier and cheaper method, positive information may be had on the formations encountered at shallow depths.

This information may be projected to depth to find the possible oil bearing structures. Core drills resemble shot hole drills in construction but are built heavier to meet the strain of drilling at greater depths.

The problems encountered in shot hole drilling are as many and varied as the different parts of the country to be explored. The one problem that is so troublesome at this point in the exploration for oil in Western Canada is that of transportation. Equipment suited to fast, efficient operation on the plains is entirely unsuited for work in the northern wooded and muskeg regions. The equipment used there must be able to negotiate mud and muskeg and yet do a fast, efficient job of drilling the formations encountered.[1]

There is a trend toward track-mounted equipment of light design to override these obstacles. These lighter drills will do the easier jobs quite well, but some of the tougher glacial drift deposits are located under this muskeg which are hard to penetrate with lighter rigs. Winter work when the muskeg freezes helps in some places, but the winters are very severe and it

AS A FORERUNNER in oil field exploratory work, a shot hole driller has his work cut out for him. One of the least publicized phases of the industry, the shot hole rig usually enters the picture first—drilling the shallow holes that will be used by the seismic and geological crews searching for a structure thousands of feet below the surface which might be favorable to oil accumulation.

is probably as easy to do the work in the summer over tougher roads. A great deal of thought and experimentation is necessary to get the right type of equipment at the right place at the right time.

The drilling difficulties encountered in shot hole work are many. It is possible in one day's work to encounter several different types of drilling conditions. That is, one hole may be gravel, one hard rock, and one soft, sticky formations and each requires different techniques and different equipment, such as bits, casing, and so on. The one tough problem of drilling in country that has been glaciated is the surface rubble left behind. These gravel formations are the toughest for the small rotary drill to handle. In thickness they run from a few inches to as much as several hundred feet and they usually contain sand, gravel and boulders of varying sizes that are very hard to penetrate. Rock bits are required here in most cases, which slows down drilling. At the same time these boulders are embedded in clay and a drag bit is required for that. Therefore, there is a constant changing of bits and a loss of time. The soft, sticky formations make it difficult to keep the hole clean and drilling is slow under those conditions. In some areas there are lost circulation zones or blind zones. These are porous sands or gravels, or the harder formations that have been shattered. Drilling mud, sawdust and fibrous materials are required to seal off these sections. In extreme cases cement is used.

It is much harder for a small rig to overcome lost circulation than it is for a big rig because of the small volumes of mud that can be handled.

Winter and the elements pose the biggest problems to shot hole drilling at the present time. In winter temperatures, trucks, equipment and men take the worst beating of the year. In many cases where winter work is carried on, there are no garages or shelter for the equipment. There is the constant problem of starting cold motors, keeping batteries charged, and protecting the personnel from the cold. In addition, there is the problem of finding a water supply and keeping it in a liquid state. In subzero weather the tanks must be heated and operating time should be cut to a minimum. At the drilling location the pump and mud lines must be kept thawed so circulation of the mud does not stop. Heat around these units is usually supplied by blowtorches, wood fires or anything the crews have available.

Roads in the winter must be kept open by bulldozers. Water holes are sought and kept open for any emergencies. On many days much more time is spent thawing out equipment, hauling water and traveling through snow than is actually spent in drilling. The men work in huge parka coats and sheepskin boots, and with the combination of heavy clothing and extremely cold weather their efficiency is cut markedly.

Thaw Problems

Spring thaws also present their problems—for then the ground becomes almost bottomless mud. Actually, about half of the year is spent working under adverse climatic conditions.

The rigs used in shot hole drilling are of the small truck or trailer-mounted type, ranging in size from 200- to 2000-foot models. They vary in weight from 2000 to 30,000 pounds and are mounted on many different kinds of truck and trailer assemblies. The most popular types are the hydraulic and mechanical pull-down masts, which use two different methods of forcing the drilling bit into the ground. The hydraulic machines use a system of hydraulic cylinders and pistons to raise and lower the drill stem, while the mechanical use either chains or winched cables for the job.

The secondary parts of the rigs are nearly the same; that is, the mud pump, circulating system, the kelly and the drill pipe. Nearly all rigs get power for the rotary table and hoisting operation from the motor of the truck on which they are mounted. Some of the larger type of shot hole rigs have auxiliary motors for emergency loads. The water trucks now in universal use have vacuum pumps for loading water; the truck motor here also furnishes the power for the pumps.

Shot hole rigs must operate in weather like this.

During recent months, several new ideas have been put forth in shot hole drilling. A small, extremely light weight auger-type drill is coming into prominent use. The drill has not been proven in every type of formation, but in soft, sticky drilling it has the advantage of speed. The main factor in favor of the auger drill is its added portability and the fact that water is not needed during drilling operations. It can be seen that this latter factor would be most important in winter months and in country where water holes are few and far between.

Another development, still in the experimental stage, is the use of compressed air as a circulating medium in place of water or mud for cleaning the hole. This method is adapted to and used on standard type rigs, using the same type bits and drill stem. A major company in the U. S. has been experimenting with this method of drilling and probably has a detailed record of its advantages and disadvantages, but for Canadian operations its advantages are again apparent in winter work and in areas where water is in short supply. One difficulty is developing compressors large enough to handle the air volume required. The weight of the compressors may seriously cut down the portability of the present rigs.

Shot hole drilling will be necessary as long as geophysical and geological exploratory work is done. The amount of the work carried on will depend upon the law of supply and demand for petroleum products. New methods concerning the application of shot hole drilling, new equipment, new methods of transportation, new methods of drilling and increased efficiency must all be developed if shot hole drilling is to keep pace with the rest of the industry.

ACKNOWLEDGMENT

This paper was originally prepared for "Oil in Canada" with whose permission it is published here.

About the Author

W. A. BURGGREN has spent 17 years in the oil business, three as a roughneck and a driller, and 14 as the head of Burggren Exploration and Drilling Company in Southwestern U. S. and Canada. He was recently elected president of the Exploration Drilling Contractors Association of Western Canada — an organization set up to coordinate the activities of the shot hole fraternity in the world's second most active exploration area.

AERO MAPS THE FUTURE!

ONLY a few hundred feet above Canadian muskeg, an AERO crew lowers the sensitive magnetometer from the survey plane into recording position. Swiftly, accurately, economically, it collects magnetic data to speed exploration in the Peace River area.*

In the skilled hands of AERO mapping engineers, the airborne magnetometer plays an important part in the worldwide search for oil. In Tunisia, Mozambique, the Bahamas, Cuba, and the United States, AERO magnetometer surveys have been materially helpful in the selection of areas for further exploration and development.

Let AERO bring its 31 years of mapping experience to your conference table. Our photomosaics and topographic maps, and our aeromagnetic surveys, will save time, money, manpower for you. Write AERO today.

**In the Dominion of Canada, aerial mapping-magnetometer surveys are performed by our affiliate, Canadian Aero Service, Ltd., of Ottawa.*

TOPOGRAPHIC MAPS • PLANIMETRIC MAPS

PRECISE AERIAL MOSAICS • AIRBORNE MAGNETOMETER SURVEYS

RELIEF MODELS • COLOR PHOTOGRAPHY

AERO

SERVICE CORPORATION

236 E. COURTLAND ST., PHILA. 20, PA.

Oldest Flying Corporation in the World

Philippines Look to Increased Oil Activity

By DEMETRIO ANDRES
Director of Mines, Republic of the Philippines

WITH MUCH of the Far East disrupted by war or the threat of war, the continued operation of foreign oil companies in parts of that area is uncertain at best. The narrowing sphere of friendly nations has caused American oil operators to look to previously neglected petroleum regions for future activities.

WITH the new Petroleum Act of 1949 formulated as law the Philippines anticipate new oil activity on the part of the government and foreign oil companies. The new law is held to be attractive to foreign operators in its present form.

Discovery of oil in the Philippines was recorded as early as 1888, and the search for it was begun in the Spanish era when two wells were drilled to 1128 feet in Cebu in 1896. Operations were suspended because of an uprising in 1897 but water still pushes oil to the surface in these wells.

After the Philippine revolution and the Spanish-American War, hand-drilling was undertaken on Bondoc Peninsula, Luzon Island, in 1906. The wells were carried to 328 feet by this crude method. Between 1921 and 1924, Richmond Oil Company drilled four wells in the same area to a maximum depth of 4900 feet. These latter drilling operations found oil and gas indications but no commercial production was attained. One zone of the Bondoc Peninsula was said to have tested 92,000 cubic feet of gas per day.

At about the time the U. S. Congress was considering a law granting independence to the Philippines, more enthusiastic interest in the search for oil in the Philippines was registered. Many applications for geological exploration leases under Act No. 2932 or the Petroleum Act of 1920 were received from Filipino and American citizens and corporations, including reputable American oil companies. But in view of the unrestricted speculative activities undertaken by some promoters at the time, the government was constrained to cancel most of the geological exploration leases then existing and to reject all pending applications.

Three of the leases which remained uncancelled are those presently being operated by Philippine Oil Development Company (formerly Far East Oil Development Company), one with an area of 31,181 acres in Daanbantayan at the northern tip of Cebu island, and the two others comprising 16,290 acres in the Bondoc Peninsula in southern Luzon.

Before the enactment of the Petroleum Act of 1920, petroleum rights were acquired by making locations of not exceeding 158 acre-tracts of petroleum lands after the discovery of oil seepages or other indications of oil deposits. This provision was carried under the Act of the U. S. Congress of July 1, 1902, as amended, for the Philippines. There are now three petroleum claims of 158 acres each, situated in the Bondoc Peninsula, now held to be patented under the said Act by the Maglihi Petroleum Mining Associations.

Revision of Government Policy on Oil

In 1938, President Quezon submitted to the Philippine National Assembly a draft of an agreement proposed to be entered into between the Philippines and Standard Vacuum Oil Company for the exploration and development of the Philippine petroleum resources. However, this was not acted upon by the legislative body and instead a law was passed (Commonwealth Act 351) declaring it to be the policy of the government to undertake the search for, exploitation, and development of the petroleum and gas resources of the Philippines; and in such undertaking, to engage and utilize, if necessary, the services as independent contractor or contractors, of persons or corporations with adequate resources, experience and organization to render such services effectively.

This would take effect after the efforts to discover and develop such resources in the Philippines, through the issuance of leases under the leasing law of 1920, had not proven successful. In order to carry out this policy, the president of the Philippines was authorized to call for bids upon adequate advertisements for the exploration, exploitation, and development, as independent contractor or contractors, of the petroleum and gas deposits in the Philippines. This would depend upon such terms and conditions agreeable to the government.

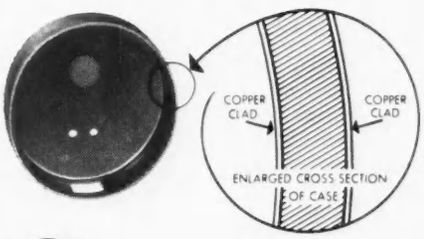
In a bid called for the purpose, only Standard Vacuum, which holds a sizeable portion of the local oil market, submitted a bid; but for technical reasons the bid was rejected. Not finding a satisfactory solution to have the search for oil in the Philippines undertaken by private entities, the government enacted the law of 1939 suspending for five years the granting of oil leases under the leasing law of 1920. The law would enable the government to undertake the exploration, development and exploitation of its petroleum and gas resources. This suspension was extended by the late President Quezon for another period of five years when he issued Executive Order No. 11-W, dated March 21, 1944, in Miami Beach, Fla. At the time the Philippine government was in exile in the U. S. because of the war.

Exploration by Government

With the suspension of the granting of leases under the law of 1920, the search for oil was not, however, diminished. The government through National Development Company conducted an extensive geological reconnaissance of the Philippines which was unfortunately cut short by the outbreak of war in 1941. This geo-

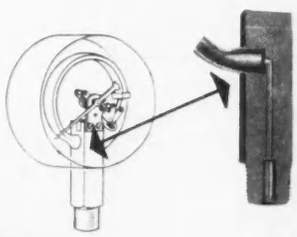
A NEW Xmas Tree Gauge

TAKE A GOOD LOOK at the facts presented below and we believe you'll agree that this is the finest Xmas Tree Gauge ever developed!



1 NEW *Marshalloy* CASE

A brand new conception in gauge housings. It is corrosion resistant, four times as strong and one-third lighter than conventional iron cases. It is made of copper-clad wrought steel of boiler plate thickness. It is much less likely to corrode than iron or steel, but has the strength of heavy-gauge steel. Known as "Marshalloy," it has all the advantages of plastic or die-cast cases, but none of the disadvantages. It can't be broken like a plastic or die-cast case. It won't rust or corrode. It has four times the strength of cast iron, but only two-thirds the weight. Finished in a new corrosion resistant, satin black enamel, and fitted with Marsh safety blow-out plug, it is the finest case you have ever seen.

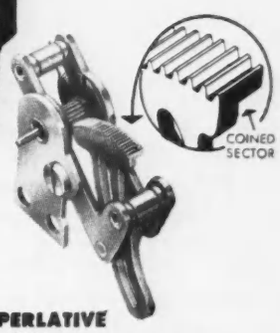


2 NEW *Conoweld* TUBE

Tube, socket and end-piece "Conowelded" into an integral unit

To insure absolute dependability, a gauge must be made permanently leak-tight from inlet to end-piece of the bourdon tube. This has always presented a tough problem, but here is the final solution. By a special process the tube is "Conowelded" into socket and end-piece to form the equivalent of one-piece construction. The tube is then accurately tempered to required resiliency.

The unretouched photo of a socket sawed in half shows the perfect fusion of the joint at the point where the bourdon tube enters the socket—the joint that is most difficult to make. Photomicrographs are also available to prove the perfection of this process.



3 SUPERLATIVE *Mastergauge* MOVEMENT with coined sector

The crowning touch to the Xmas Tree Gauge is the Marsh "Mastergauge" Movement. In tens of thousands of Marsh "Mastergauges" this finer movement has proven its ability to stand the gaff of oil country service better than any other.

Notice the broad pinion gear and coined sector gear surfaces with teeth cut to the highest standards of precision. The coined form (see enlarged section) is a typical Marsh refinement — a form that gives greater strength where greatest strength is needed. Unlike metals, giving a self-lubricating frictionless effect, are used throughout. It is a movement in keeping with the advanced design and construction of this new Gauge.

MARSH INSTRUMENT CO. Sales affiliate of Jas. P. Marsh Corp. **Dept. K, Skokie, Ill.**

Houston Branch Plant **1121 Rothwell St., Houston, Texas**

MARSH GAUGES

logical survey was conducted by a team, acting under advice of the late Dr. H. Foster Bain, with Dr. Grant W. Corby as chief geologist.

A report on that work, consisting of nine volumes, was submitted by Dr. Corby before the war to President Quezon. This report covers a geological reconnaissance of 32 provinces, approximately 42 percent of the total land area of the Philippines, and a more detailed reconnaissance to determine underground structures and formations of the provinces of Tarlac, Panay, Cebu, and Leyte. The survey thus far recognized in the Philippines three oil-bearing horizons which occur in the Netherlands East Indies and delineated favorable structures for oil accumulation.

Postwar Problems and Efforts

After the last war, the Philippines lay prostrate amidst the debris and rubble of destruction, with a disrupted economy, and National Development Company lacking in sufficient funds, technical men and organization to carry on the geological survey begun before the war. Negotiations for the exploration and exploitation of the oil resources of the country by Standard Vacuum were continued after the liberation and during the establishment of the Republic of the Philippines. Before the negotiations could be brought to a close, the president of the Philippines was authorized to appoint a commission to make a thorough study of the petroleum situation.

Immediately after the creation of the commission, other proposals were received from private individuals and entities. Some applied for concessions and others offered to undertake the search and development of the oil resources of the Philippines for and in behalf of the government. Among the entities that submitted proposals were three reputable Americal oil companies with operations in other parts of the world. However, in view of the enormous areas covered by some of these proposals, overlapping each other in certain portions thereof, all such proposals were not accepted.

New Philippine Oil Law

Soon thereafter, the government sent a mission headed by the author to oil-producing countries of the world. The mission was to study the best methods of providing for the exploration, exploitation, development and utilization of the petroleum and gas resources of the islands. The purpose of the mission was to observe the modern methods of petroleum operations and the trends in progressive oil legislations. The result of such study was the draft of an oil law, which became known as the "Petroleum Act of 1949," taking effect on June 18, 1949.

Under the new law, a maximum area of 1 million hectares (2,470,000 acres) may be granted to an applicant for exploration concessions and 500,000 hectares (1,235,000 acres) for exploitation concessions. Exploration concessions are granted for a maximum period of ten years and exploitation concessions for a term of 25 years renewable for a like period of 25 years. In general, the provisions of the new oil law are fair enough both to operators and the government, and it is believed by men of the industry that in its obvious intent the law should attract genuine interest on the part of internationalized oil companies.

While it has been pointed out that the new law grants concessions only to private enterprises 60 percent Filipino-owned, it should be added that under the so-called "parity amendment" to the Philippine Constitution, citizens of the U. S. and business enterprises owned or controlled by them directly or indirectly, are given until 1974 the same rights as Filipinos and Filipino enterprises in the development and exploitation of Philippine natural resources, including petroleum. Moreover, there is a provision in the new oil law whereby under a contract of service foreign concerns may operate, as independent contractors, Philippine petroleum lands for the government under such terms and conditions as may be deemed fair and just to both parties. This contract may even extend beyond 1974.

Table 1
Analysis of Second Gas Sample

	Mol. Percent	Liq. Vol. Percent	Gals./1000 Cu. Ft.
Methane	95.56	92.21	.....
Ethane	1.12	1.63	.....
N Butane	2.69	4.84	.848
Iso Pentane	.54	.94	.1645
N Pentane	.11	.23	.0398
N Hexane	.07	.15	.0266
	100.00	100.00	1.0789

Calculated Specific Gravity, .6141
BTU (British Thermal Units), 1100 per cu. ft.

Table 2
Second Analysis

	Mol. Percent	Liq. Vol. Percent	Gals./1000 Cu. Ft.
Methane	99.73	99.51	.....
Ethane	.04	.06	.....
N. Butane	.23	.43	.07251
	100.00	100.00	.07251

Specific Gravity	.5587
BTU per Cu. Ft.	1093
Carbon Dioxide	1%
Oxygen	Nil

The nine-volume report containing the results of the geological survey conducted by the government before the war is now in the process of being printed and will soon be available to the public at nominal cost. It is expected that the interest shown by oil investors and operators in Philippine oil resources before will be accentuated now that more concrete information and data on Philippine structures can be had to supplement a projected program of exploration and exploitation.

At present, the areas being operated are the three drilling leases held by Philippine Oil Development Company mentioned before. This company also has an exploration application approved, under the new law, covering an area of approximately 247,000 acres in the provinces of Pampanga, Bataan, and Bulacan near the Manila Bay. The Maglihi Petroleum Mining Associations are proceeding to perfect their title under the act of July 1, 1902, to three placer claims of 464 acres in Bondoc Peninsula; however, no operation in the area has yet been done. There are several applications for exploration concessions pending in the Bureau of Mines. There have also been registered, in the Bureau, discoveries of oil seeps and emanations of natural gas in different regions of the Philippines. One sample of crude submitted by a discoverer in Mindanao and analyzed in the Institute of Science of the Philippines gave the following results in distillation tests:

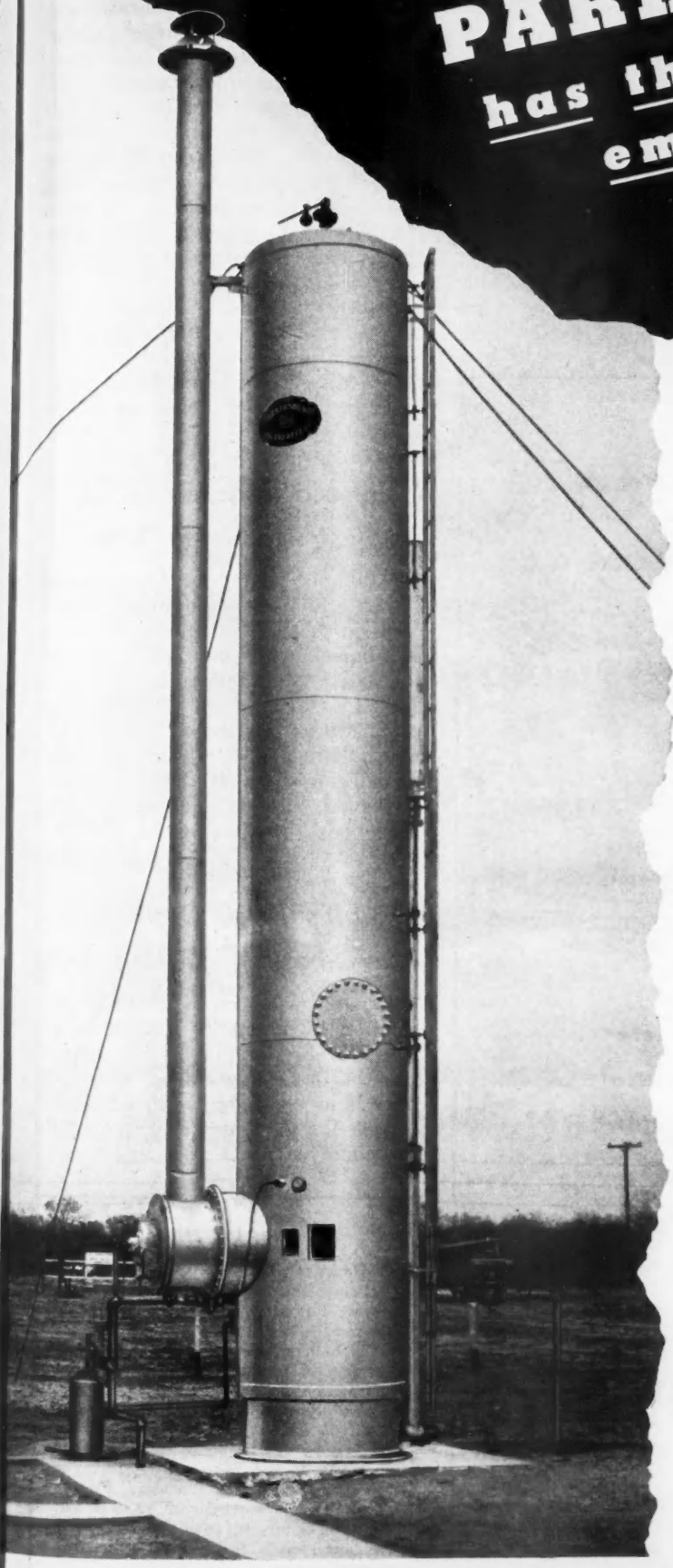
	(Approximate percent)
Fraction corresponding to kerosine range	42
Fraction corresponding to fuel oil range	42
Fraction corresponding to lubricating oil range	12.5
Residue	3.5 (by difference)

A gas sample analyzed in the U. S. for the Philippine Oil Development Company showed the result in Table 1.

Another gas sample taken from an artesian well in Macabebe, Pampanga, Philippine Oil Development Company showed the result in Table 2.

With the increasing stock of information and data on Philippine oil resources being obtained, it can be said that the Philippine oil prospect has become much brighter. The only rea-

PARKERSBURG
has the answer to your emulsion treating problems



WHETHER yours is a common emulsion treating problem or one that is extremely rare and complex, there is a Parkersburg treater of the proper type and size for maximum efficiency.

The new ETSI series, with its famous fourteen features, is available in four types and 15 sizes. The ET series, perennial leader of the industry, is available in two types, four sizes.

It will pay you to bring your treating problems to emulsion treating headquarters. Parkersburg engineering experience in the solution of scores of such problems . . . their manufacturing facilities for the production of a wide range of treaters is your best assurance of emulsion treater efficiency.

Talk to your nearest Parkersburg representative before specifying your next emulsion treater. Write for Treater Catalog ET-249 giving complete construction and operating details.

THE PARKERSBURG RIG & REEL CO.
PARKERSBURG, WEST VA.

5015

PARKERSBURG
PRESSURE EQUIPMENT

HORIZONTAL AND VERTICAL SEPARATORS • HYRECO • HYDRACEPTER • SCRUBBERS • TREATERS • HEATERS

Manufactured in Houston, Texas

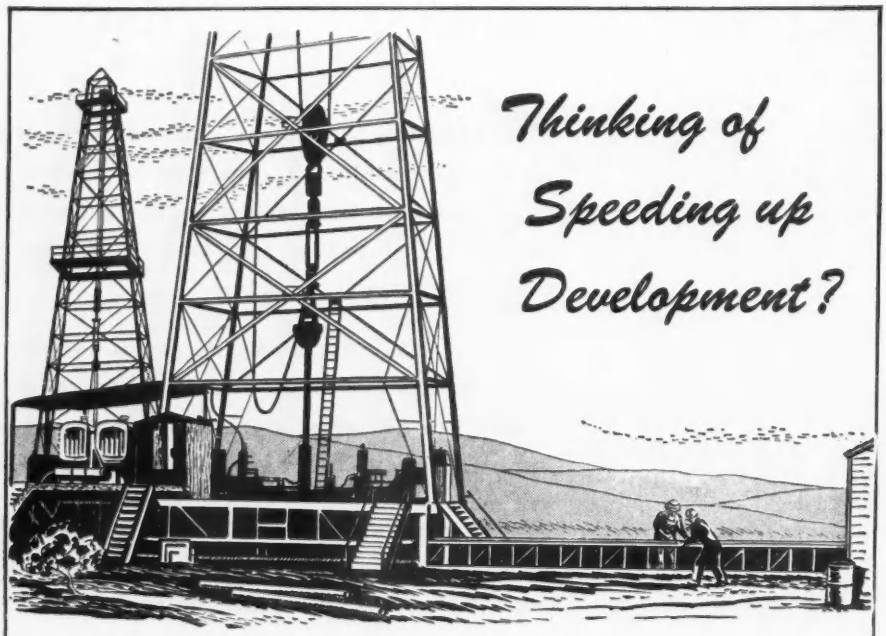
son for failure to realize commercial production in the islands is the lack of sufficient capital to sustain a projected program of operation for a period of years.

Labor in the islands is cheap, English-speaking and intelligent enough to be easily trained in technical jobs. There are no extreme hot and cold seasons to prevent year-round operations. The Philippines have a fairly large and ready market for refined products if a sufficiently large production may be realized by any operator. In 1949, the import of petroleum products was valued at the equivalent of $54.5 million.

Though the national economy is not as good as it should be, the government is endeavoring to improve this situation and it can only be done gradually. It is committed to provide incentive to new industries, especially those which are dollar-producing and dollar-saving, such as the mining and the oil industries. The securing of license for equipment, materials and supplies needed by such industries are being given top priority. Exchange control restrictions to facilitate the securing of dollars for the purchase of essential machinery, equipment and supplies, have likewise been relaxed.

With regard to peace and order, there are lawless bands roving in the mountains who occasionally come down and harass the barrio people to obtain food. Such activities are sporadic and located to limited areas immediately bordering the mountain regions in central and southwestern Luzon and are almost entirely absent in the Visayas and Mindanao areas. The mining companies operating gold, manganese, iron, chromite, and coal mines, and the operations of Philippine Oil Development Company, practically have not been disturbed by these dissident elements. However, the government upon request of the operators will extend the necessary protection.

In order to make the country self-sufficient in oil, the Philippines will continue the search for oil in its territory, dissociated from the explosive situation in other countries of the East.



Thinking of Speeding up Development?

Producers of oil and natural gas are invited to consult with our Oil Department for aid in financing *accelerated development drilling programs.*

All inquiries on petroleum and related matters will receive prompt attention.

Empire Trust Company
NEW YORK

Downtown Office:
120 BROADWAY
Equitable Building

Uptown Office:
7 W. 51st STREET
at Rockefeller Center

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

Colombia Believes 1950 Its Best Producing Year

Colombia, second largest producing country in South America, expects 1950 oil production to exceed 32 million barrels when the final figures are tabulated. Production in 1949 was 29,643,979 barrels, or a daily average of 81,250 barrels. Production for October, 1950, was 3,061,731 barrels, or a daily average of 98,800 barrels. However, the average for the year has not run this high and will probably be about 87,750 barrels per day.

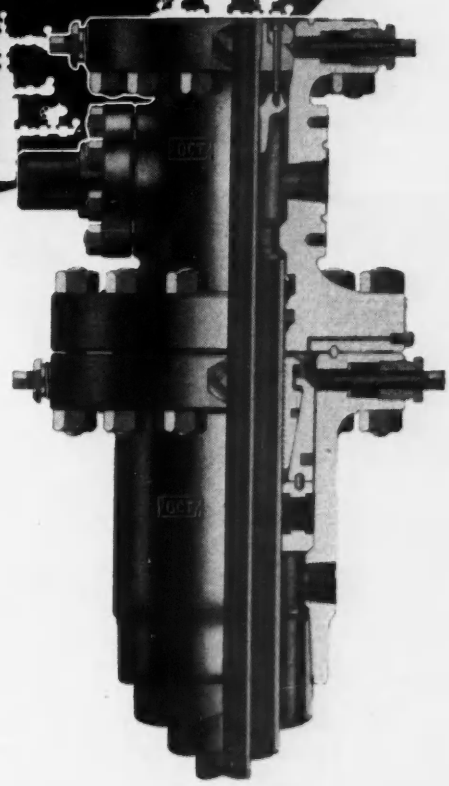
Kuwait's 1950 Production May Show 37 Million Gain

Kuwait will exceed 1949 oil production by about 37 million barrels in 1950. Production for the first 11 months of 1950 totaled 114,649,401 barrels as compared with 82,639,040 barrels for the comparable period the previous year.

CORRECTION

Omission of the word "dollar" in the article, "Canada's Big-Inch Now Operating," as it appeared on page 195, December WORLD OIL, created an erroneous impression of the cost of transporting Canadian crude. The boxed paragraph on that page should read: "The Interprovincial Pipe Line from Central Alberta to the Great Lakes will cut the transport cost dollar for oil down to between 23 and 24 cents a barrel. The cost to ship this oil the same distance by rail would approximate $2.43 a barrel." In short, the pipe line will haul Redwater crude to Superior at about 56 cents per barrel and Central Alberta crude from Edmonton to Superior at about 54 cents per barrel—or about one-fourth the cost of rail shipments.

WHETHER YOU BUY WITH DOLLARS OR POUNDS STERLING



The same dependable O-C-T equipment is available

IN YOUR EXCHANGE

In order to make American-designed oil well pressure control equipment immediately available in unlimited quantities to oil producing areas throughout the world, Oil Center Tool Company was the ***first*** oil equipment manufacturer to license manufacturers in both Canada and England. So now, whether you operate in the United States, Canada, or a pound-sterling area, you can buy the same dependable O-C-T equipment in your local exchange.

In Canada, O-C-T equipment is available from Canadian-Vickers, Ltd., in pound-sterling areas from LeGrand, Sutcliff & Gell, Ltd., and in the United States from Oil Center Tool Company or your nearest supply store. These O-C-T products have been designed with specific oilfield needs in mind . . . manufactured with dependable performance in mind . . . and sold with service in mind. Write today for complete information on Oil Center Tool Company wellhead equipment. We will be glad to give you details on the O-C-T policy that makes dependable equipment immediately available to you in your exchange.

Oil Center Tool Co.

P. O. Box 3091, Houston, Texas

Canada — Canadian-Vickers, Montreal, Canada

Sterling Areas — Le Grand, Sutcliff & Gell, Ltd., Southall, Middlesex, England. Address Export Inquiries for **All Other Countries** to P. O. Box 3091 Houston 1, Texas.

MIDDLE EAST PATTERN CHANGED

Aramco Makes Deal . . . Iran Talks Fail

TWO separate developments last month rocked the long-established Middle East petroleum pattern—developments which may revolutionize the arrangement of oil concession contracts in the Persian Gulf area and entail widespread repercussions in many producing countries.

● Arabian American Oil Company (Aramco) agreed to share its profits half-and-half with the Saudi Arabian government on all oil lifted in the lush Arabian fields.

● Two years of negotiations between the government of Iran and Anglo-Iranian Oil Company, biggest Middle East producer, collapsed when Iran threw out all previously pending agreements and left the fate of the British A-I concession and its operating terms in complete uncertainty.

Meanwhile, the prime diplomatic question came into focus: Do the Middle East producing nations intend to swing to the Russian orbit if they cannot win improved contract modifications from American and British operators? Will Russia be able to capitalize on the self-interests of Middle East oil-producing nations and wean these countries and their petroleum resources from the Western World?

The Aramco agreement, made retroactive to January 1, 1950, provides that the company will pay up to, but not to exceed 50 percent of net profits on its Saudi Arabian operations as income tax in addition to maintaining current royalty rates. Aramco is owned 30 percent each by Standard Oil Company (N. J.), Standard Oil Company of California and The Texas Company, and 10 percent by Socony-Vacuum Oil Company.

On the basis of present production levels, the 1950 share of Saudi Arabia will exceed $100 million, of which about $65 million will be in the form of royalties and $35 million will be derived from the new tax accord. The company will continue to pay a royalty of four gold shillings a ton, originally worth about $8.25, at the international monetary fund rate, but now valued at about $12. This will guarantee the Saudi Arabian government at least 22 cents a barrel royalty.

The purpose of the new agreement is to provide that Aramco pay an income tax such that will make total payment to the Saudi Arabian government equal to one-half the net operating income of the company. Saudi Arabia has conceded that all payments shall be made at the international monetary fund rate of exchange, including the conversion of Saudi Arabian reals to cover wages and other charges. This in effect abolishes the previous system of pegged exchange rates.

The pact was signed December 30 at Jidda following two Saudi Arabian royal decrees, the second of which on December 27 imposed a 50 percent income tax on all foreign companies in that country. Aramco negotiators flew to Jidda and after a brief conference with Saudi Arbian officials, the new agreement was announced. In actuality, it will mean a charge on Aramco of about 50 cents a barrel for all oil produced.

It is expected that the arrangement will bring new demands on other American and British companies in the Middle East. Among new principles established by the Aramco settlement is that of the right of a country to tax an oil concession and its earnings. Previously concession terms did not cover this right.

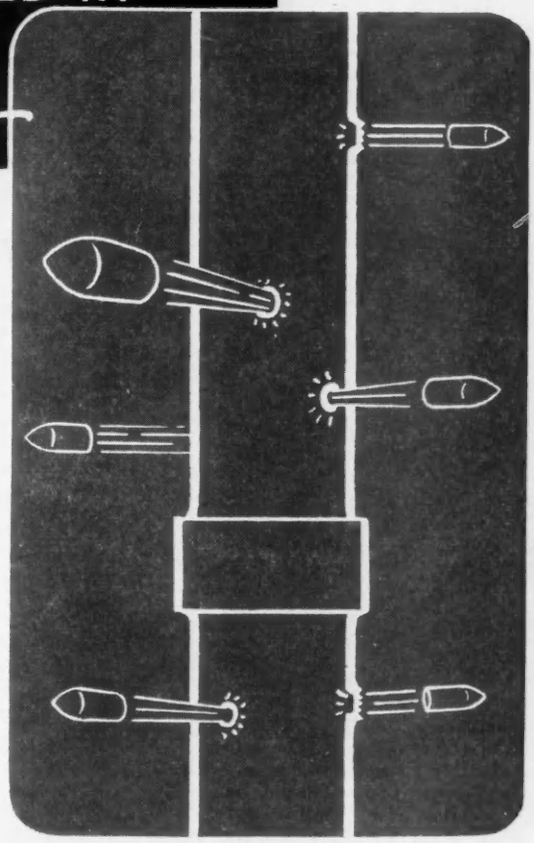
First repercussion of the deal is expected to be in Iran where the Iranian government already has rejected an offer of the Anglo-Iranian Oil Company raising royalty rates to 34 cents a barrel and providing other cash benefits of about 9 cents a barrel.

The procession of Middle East nations demanding more and more revenue from foreign oil operating concerns began early in 1949 when Pacific Western Oil Corporation offered the highest terms ever until then extended in the Middle East—a royalty rate of 55 cents a barrel and an initial cash bonus of $9½ million. At that time it was said that such terms would set off an unending round of negotiations for higher returns to the companies. Since then Iraq, Syria and Egypt have demanded more favorable concession contracts, and in the words of one industry economist, "This may be just the beginning of the road which could eventually end in confiscation."

Gotkool
WATER CANS
& COOLERS
GOTT Water Coolers are the convenient way to keep drinking water handy to the worker, protect it from impurities. Their exclusive construction keeps water cool for long periods. Snug fitting large removable top, handy non-leaking push button faucet. GOTT Water Cans for handy field use. Your Supply Store has them, get one today! . . . .
GOTT
GOTKOOL
WATER COOLER
PURE WATER
GOTKOOL WATER COOLER
Made in 2, 3, 5, 8, 10, 15 and 20 gallon sizes with Push-Button Faucet.
GOTKOOL WATER CAN
Made in 1½, 2, 3, 5, 10, 15 and 20 gallon sizes. (Push-Button Faucet at slight additional cost.
H. P. GOTT MFG. CO.
WINFIELD, KANSAS
KEEP PURE DRINKING WATER ALWAYS HANDY

10 Gun Perforating Service Companies

HAVE THEIR CATALOGS FILED IN Composite Catalog



FOR FAST, ACCURATE BUYING DECISIONS

WHEN you buy or specify gun perforating or any other oil field or pipe line service there's a need to compare before you make a decision. And there's a need to be fast in deciding.

That's when you should reach for the Composite Catalog. Most service companies and oil field equipment manufacturers have their catalogs filed between its covers . . . All the information you need for adequate comparisons of more than 2900 different types of services and products by 500 different concerns.

THE UNIVERSAL EQUIPMENT GUIDE FOR OIL COUNTRY BUYERS

COMPOSITE CATALOG

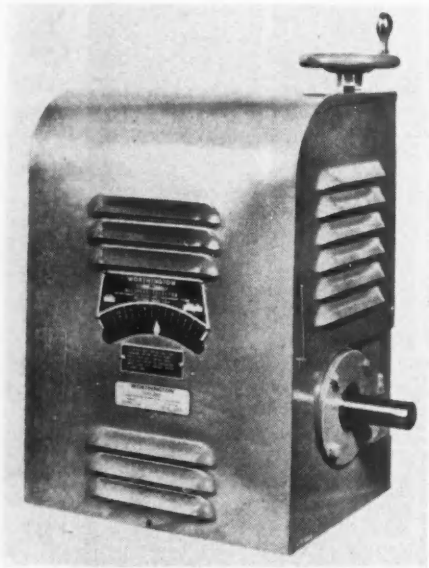
DESCRIPTIONS OF NEW EQUIPMENT IN THIS ISSUE OF WORLD OIL ARE SUPPLEMENTS TO THE MANUFACTURERS' PRE-FILED CATALOGS IN THE COMPOSITE CATALOG

NEW AND IMPROVED EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Transmissions

This item supplements Worthington Pump and Machinery Corporation data on pages 5145-5164 of Composite Catalog, 17th Edition.



A new variable speed transmission with tandem belt design, known as the Worthington Allspeed Drive, consists of six models, rated at 1, 3, 5, 7½, 10 and 15 horsepower, respectively, and with variation of 16 to 1, 10 to 1, 9 to 1, 8 to 1, 6 to 1, and 6 to 1 respectively. At 1725 revolutions per minute input, the 1 horsepower unit offers a range of 215 to 3450 rpm.; while the 15 hp unit will vary from 370 to 2220 rpm with an input speed of 1750 rpm.

Tandem belt design permits the drive to be applied where space is limited, and each unit is available for vertical or horizontal operation, to run in either direction.

Handwheel control is standard with electrical remote controls also available.

For additional information, write Worthington Pump and Machinery Corporation, Allspeed Drive division, Holyoke, Mass.

Pipe Protector

This item supplements Tuboscope Division data on pages 4790-4791 of Composite Catalog, 17th Edition.

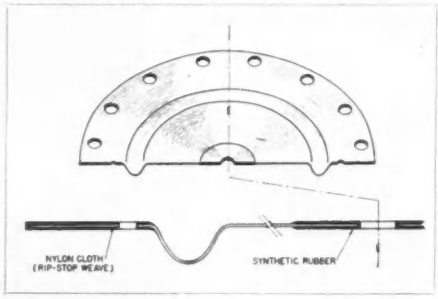
A laminated rubber protector for drill pipe and casing, the Tube-Tector, grips the pipe with a pressure of more than 1000 psi. This pressure minimizes the possibility of movement on the pipe and reduces ring cutting and the chance of losing protectors in the hole. The protectors are placed directly on the pipe, without use of transfer sleeves, as pipe is being run in the hole, and can be installed in only three seconds on the rig floor. Tube-Tectors are always enclosed completely within the cylinder of the applicator at the time of original expansion when stress is greatest.

For additional information, write Tuboscope Division of Tubular Service & Engineering Company, Commerce Building, Houston.

Nylon-in-Rubber Diaphram

This item supplements Rockwell Manufacturing Company data on pages 3581-3612 and 4104-4107 of Composite Catalog, 17th Edition.

Strengthened with nylon fabric, a new molded synthetic rubber diaphragm improves the precision of gas pressure control with high pressure balanced valve pilot loaded regulators, the manufacturer claims. Because of the heat molded shape of the circular trough which lies between the case clamping ring and the diaphragm clamping plates, the free area of the diaphragm rolls easily and smoothly. This minimizes pressure variations due to changes in effective diaphragm area with change of diaphragm position. Rubber is extra thick at



both the peripheral and central clamping zones. Seepage of high pressure gas along the fibers of the inserted fabric is prevented by the special type of weave used, and by sealing off the nylon insert well back from the outer diaphragm edge.

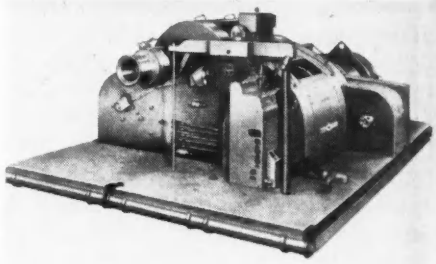
For additional information, write Rockwell Manufacturing Company, 400 North Lexington Avenue, Pittsburgh 8.

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

Drilling Rig

This item supplements The National Supply Company data on pages 3433-3564 of Composite Catalog, 17th Edition.



A new drilling rig for medium depths, known as the Type 75-CA Consolidated Rig, is designed for 650 input horsepower and is normally for drilling in the 6500-9500-foot depth range.

The new rig supersedes the Type 75 rig. New design includes (1) Ideal Dy-A-Flex air clutch for the high drum drive, (2) air-operated Twin Disc Model "P" air clutch for rotary drive, (3) separate, centralized control cabinet for air operation of the rig, (4) 1½-inch pitch quadruple engine-to-drawworks drive chain, (5) notched drawworks base for step down location of drive group, and (6) full enclosure and oil bath lubrication of all chain drives.

Air is used to control all of the major operations of the rig, including the catheads, drive group engine throttles and clutches, master clutch, inertia brake, and pump drive clutches.

The hoisting drum is 23½ inches in diameter and 35 inches long. Two Ideal 46-inch diameter by 10⅜-inch wide water cooled brake rims on the drum are made of roll-forged and heat-treated seamless alloy steel. Auxiliary brakes are optional and may be either a 36-inch or 40-inch single Hydromatic with foot pedal control at the driller's position or the 5019 or 5032 Dynamatic brake with hand control at the brake position.

The drawworks provides six hoisting speeds, three rotary speeds and three catshaft speeds. Three forward and one reverse speeds are provided by a two-shaft transmission. Speed selection is made through jaw clutches actuated from a single control lever.

The rig may include one of several optional Type "B" drive groups. Although two engines in the 250 to 400 hp range are normally used with this rig, three engines may be used when more power is required for increased pump capacity. Usually pumps such as the Ideal C-250 and C-350 are used.

For additional information write The National Supply Company, P. O. Box 899A, Toledo, Ohio.

Why 5 Grades of "Oilwell" SUCKER RODS?

...TO GIVE YOU the utmost in rod-service-per-dollar-invested, no matter which of the 5 types of well conditions you have!

1. NORMAL OPERATING CONDITIONS

Grade "N"—A uniform quality carbon-manganese steel rod, fully normalized after forging to neutralize end-stresses of forging—**proven for years in non-corrosive operations.**

2. MILD CORROSION CONDITIONS

Grade "T"—A modified "4615" controlled open-hearth nickel-molybdenum alloy steel rod—quenched, tempered and stretch-straightened while hot to give good resistance to corrosion and permit above-average loading in most wells—**the industry's outstanding all-purpose rod.**

3. CARBON DIOXIDE CONDITIONS

Grade "L"—A special analysis controlled fine-grain rod of alloy steel, normalized and tempered to be most resistant to this particular form of corrosive action. **This rod has exceptional fatigue resistance.**

4. HYDROGEN SULPHIDE CONDITIONS

Grade "S"—A special electric-furnace low-metalloid steel rod of high nickel-molybdenum content, developed especially to withstand severe sulphide corrosive action — **extra low carbon resists sulphide, but liquid-quenching gives toughness and strength.**

5. HEAVIEST LOAD CONDITIONS

Grade "W"—A special analysis high-alloy steel rod that is quenched, tempered, stretch-straightened while hot and proof-tested to achieve maximum load-carrying capacity — **setting new service records at great depth or for use where tubing size is limited.**

"Oilwell's" 5 grades enable you to buy the rods best suited for each well condition. When chemical composition and physical properties of rods correspond with well requirements . . . **you save both time and money.**

Let an "Oilwell" Representative help you select the RIGHT SUCKER RODS for each pumping condition

OIL WELL SUPPLY COMPANY

Branches Serving All Oil Fields

Executive Office—DALLAS, TEXAS
Export Division Office—
30 ROCKEFELLER PLAZA
NEW YORK 20, N. Y.

Division Offices—CASPER, WYOMING
COLUMBUS, OHIO . . . DALLAS, TEXAS
HOUSTON, TEXAS...TULSA, OKLAHOMA
LOS ANGELES, CALIFORNIA

USS TRADE MARK

"OILWELL" TRADE MARK

UNITED STATES STEEL

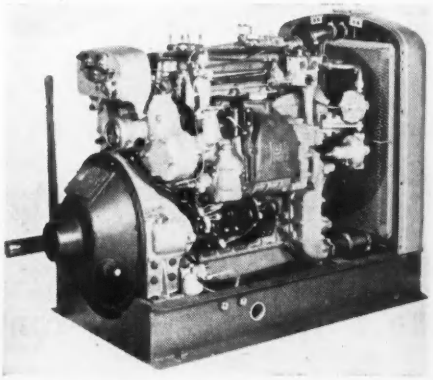
Diesel Engine

This item supplements Detroit Diesel Engine Division data on pages 1366-1369 of Composite Catalog, 17th Edition.

A diesel engine that runs on natural gas, using only a minute pilot charge of diesel fuel as an ignitor, is a conversion of the Series 71 diesel engine. When converted the engine operates both on natural gas with the pilot charge of diesel fuel, or on diesel fuel alone. Both are burned with the same thermal efficiency.

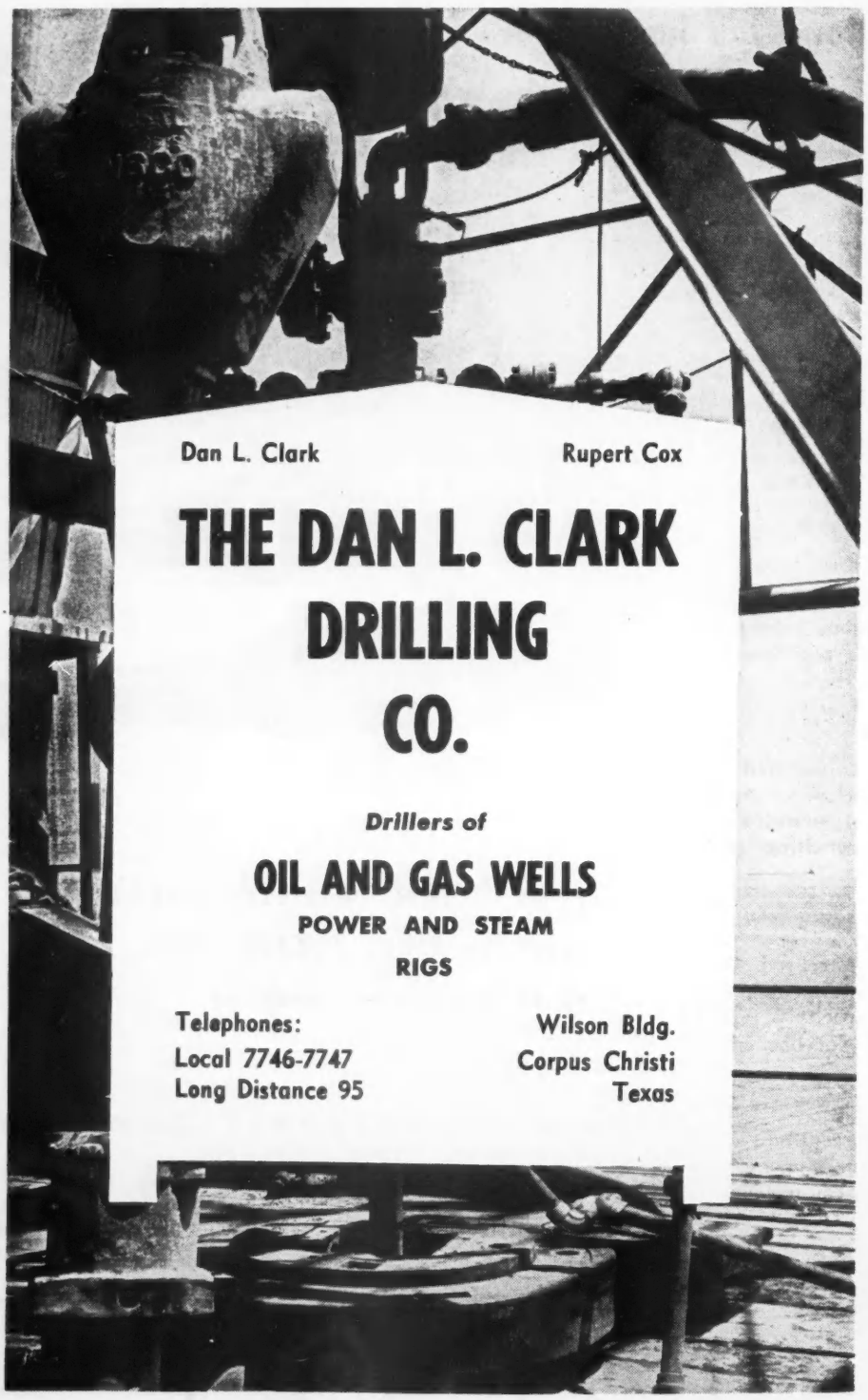
Equipment necessary for the conversion is optional on new engines, or is available as a kit for engines now in use.

Change from dual-fuel to diesel fuel operation is accomplished by moving a small lever on the gas governor assembly. The changeover arrangement is especially suitable for use by operators working in natural gas areas and in areas where natural gas is not available.



The dual-fuel unit has no electrical ignition system. Natural gas is delivered to the cylinder and fired by a small charge of diesel fuel at the top of the compression stroke. The engine instantly adjusts itself between the use of natural gas (with a pilot charge of diesel fuel) and straight diesel fuel in case the gas pressure falls off partially or completely. An automatic shut-off valve activated by the rise and fall of engine oil pressure cuts off the flow of gas when the engine is not in use.

For additional information, write Detroit Diesel Engine Division, General Motors Corporation, 13400 West Outer Drive, Detroit 28.



Tractor

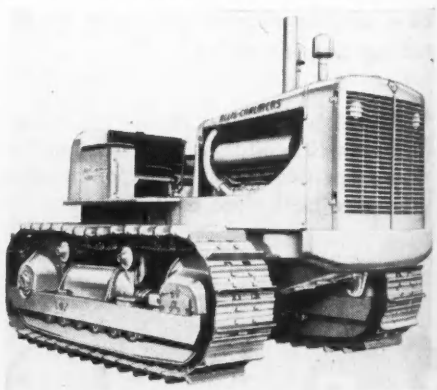
This item supplements Allis-Chalmers Manufacturing Company data on page 180 of Composite Catalog, 17th Edition.

A new torque converter equipped tractor, the HD-20, weighs 41,800 pounds and is powered by a two-cycle GM 6-110 diesel engine. A three-stage hydraulic torque converter eliminates most gear shifting and keeps the tractor working smoothly at higher average speeds.

Positive-seal, grease packed truck wheels, idlers and support rollers are serviced at the factory and thereafter require greasing only once every 1000 hours. For the operator's convenience, the seat and brake pedals are adjustable and the steering mechanism is hydraulically powered.

The 106⅜-inch track with its welded A-frame provide a high degree of stability, the manufacturer claims.

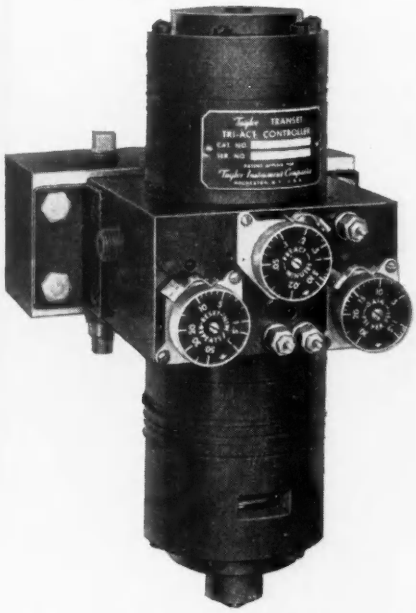
For additional information, write Allis-Chalmers Manufacturing Company, Tractor division, Milwaukee 1, Wis.



NEW EQUIPMENT
SUPPLEMENTING COMPOSITE CATALOG

Controller

This item supplements Taylor Instrument Companies data on page 4650 of Composite Catalog, 17th Edition.



A force-balance, non-indicating controller, the Transet Tri-Act, has been developed for pneumatic transmission systems. The controller accurately measures rapidly changing temperatures and pressures and gives a continuous record on a 30-day strip chart. The new circuit of the Tri-Act contains two closed loops in series, the first containing fixed proportional response and adjustable rate action, and the second with adjustable proportional response and adjustable automatic reset. The miniature pneumatic receiver is 4⅜ x 5 inches.

The controller has a high capacity relay air valve, self-sealing manifold, a new non-rotating type needle valve, and built-in orifice cleaners and air strainers.

For additional information, write for Bulletin 98097, Taylor Instrument Companies, 95 Ames Street, Rochester 1, N. Y.

Polished Rod Clamp

This item supplements Altens Foundry & Machine Works, Inc., data on pages 201-220 of Composite Catalog, 17th Edition.

Similar to but larger than the Wonbolt, Jr., polished rod clamp, the Wonbolt, Sr., has only one nut to secure and is completely self-aligning. It is made of high-tensile, heat treated malleable iron with a high tensile steel nut and bolt SAE threaded. Weighing only 12 pounds, the clamp will support a 36,000-pound load.

For additional information, write Altens Foundry & Machine Works, Inc., Lancaster, Ohio.

There are hundreds of reasons
why we should handle your
oil-banking for you. . . .

But--before we bore you. . . .

There's one BIG reason that
should sway you. . . .

And here's why it will pay you. . . .

To "oil-bank" at the
FIRST OF TULSA -
and, that is, well. . . .

The 497 actual years of experience
in oil banking by our
top personnel. . . .

So--we hope in this philosophy
you'll become immersed. . . .

In Oil -- In Banking
In Tulsa --
Think.....FIRST.

THINK 1st of Tulsa

★ In our Correspondent Bank Department, You should know, Elmo Thompson, Joe Byrd, Harry Lane, Bill McLean, and Dick Wagner.

THE FIRST NATIONAL BANK
AND TRUST COMPANY OF TULSA

MEMBER FEDERAL DEPOSIT INSURANCE CORPORATION

NEW EQUIPMENT

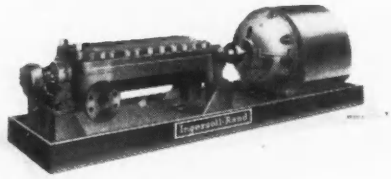
SUPPLEMENTING COMPOSITE CATALOG

Centrifugal Pump

This item supplements Ingersoll-Rand Company data on pages 2465-2472 of Composite Catalog, 17th Edition.

Multi-stage centrifugal pumps for high-pressure applications to 1200 psi and capacities to 1600 gpm, known as the Class HMTA, are built in 3-, 4-, 5- and 6-inch sizes with from 3 to 9 stages.

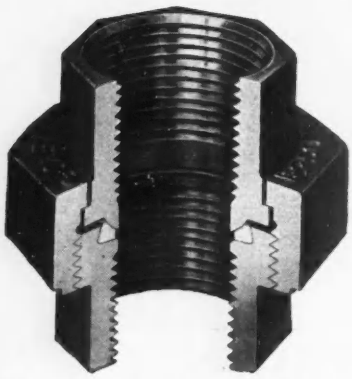
The pump has cylindrical bore, horizontally-split casing and compact, Unit-Type rotor assembly. The rotor assembly is composed of the shaft, impellers, and channel rings. These channel ring sections contain the multiple volutes and fluid passages, as well as the renewable wearing parts for each stage.



Pressure differential between successive stages in the HMTA pump is sealed by corrosion-resistant cast iron or alloy steel piston rings around the outer diameter of the channel rings. These hydraulic type, step seal rings have a metal-to-metal fit with the casing.

For additional information, write Ingersoll-Rand Company, 11 Broadway, New York 4.

Jefferson Malleable Unions



JEFFERSON'S *EXCEL* unions and union fittings available in brass-to-iron, and iron-to-iron seats. Certified Air Furnace iron used in the EXCEL line is A.S.T.M.-4733-Grade 35018 malleable, having a 53000 lb. Min. Ten.

EXCEL—
250 lb. S.W.P.—500 lb. C.W.P.

Certified Air Furnace iron produces a constant, uniform, finer grain structure union. This provides a much better iron with which to produce a positive dependable seating surface.

Unions manufactured from this malleable iron give 30% more strength; 50% more impact value; 75% more elongation. Sizes ¼" thru 3".

Obtainable through your jobber

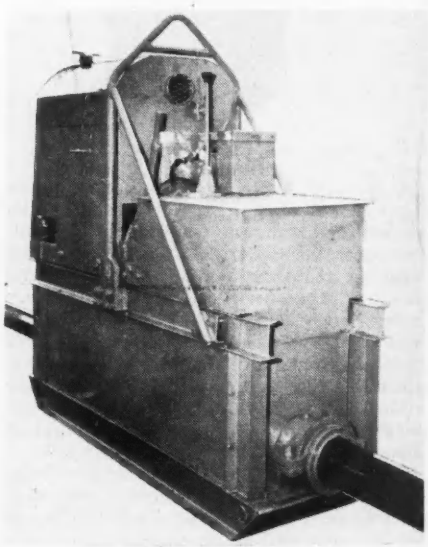
Jefferson Union Company, Inc.

691 West 26th St.,
New York 1, New York

71 Gooding St., Lockport, New York — 31 Fletcher Ave., Lexington 73, Mass.

Boring Machine

This item supplements Riley Machine Works data on page 4307 of Composite Catalog, 17th Edition.



A one-unit boring machine for drilling holes under roadways, railroads, streets or any location not reached from the surface is fully enclosed for safety. The 7-foot by 24-inch machine can be lifted by its bail into or out of a ditch or trench. It has a 100-horsepower Ford V-8 engine with a four-speed transmission. The machine can handle small as well as large diameter pipe. Bits are available in various sizes, and the drill stem is made up in 10-foot sections.

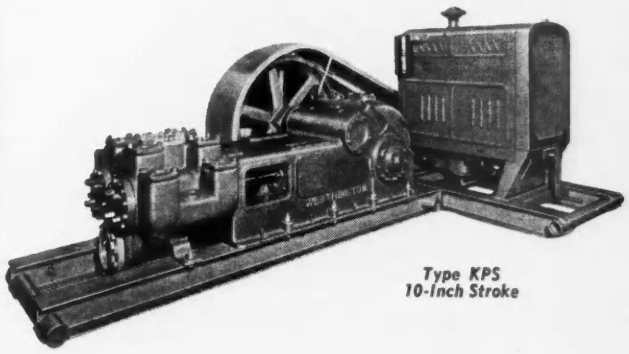
For additional information, write Riley Machine Works, Burkburnett, Texas.

For LONG TERM OIL LOANS
Repayable on Convenient Terms
Consult
PROPERTY CREDIT CORPORATION
PROPERTY CREDIT CORPORATION OF DALLAS — MORTGAGES
Mercantile Securities Bldg. — Dallas 1, Texas
Telephone: RANDOLPH 3419
Write for information about our new oil loan plan
Financing

Save Time—Write Direct

As a service to readers, all items in WORLD OIL include the complete mail address of the manufacturer. This makes it possible for those desiring additional information to write any manufacturer without the delay occasioned by going through offices of WORLD OIL, and enables subscribers to request specific data in which they are particularly interested.

LOCKETT-WORTHINGTON POWER-DRIVEN PUMP UNIT



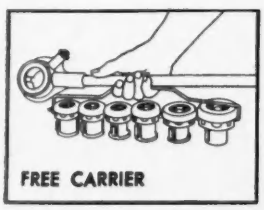
Type KPS
10-Inch Stroke

THIS Worthington Pump—like all other Worthington Pumps—can be fitted to operate with any type, or manufacture, of Engine or Motor. For dependable performance and lasting satisfaction, let a "Lockett Dealer" supply your pump-equipment needs!

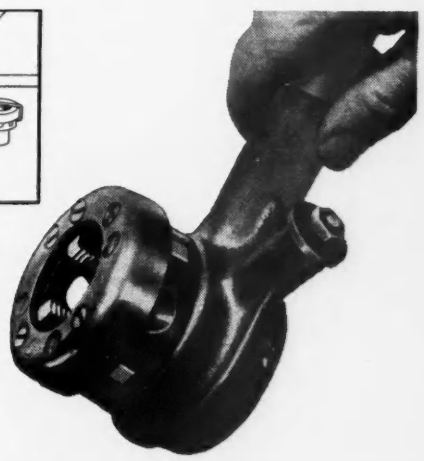
Worthington Pumps and genuine Worthington Repair Parts are available — through Lockett Dealers — from warehouses which are maintained at, or near, the principal oil fields throughout Texas and Louisiana, backed up by a large replenishing stock at our Houston and New Orleans Warehouses.

A. M. LOCKETT & COMPANY, LTD.

NEW ORLEANS **HOUSTON** **DALLAS**



FREE CARRIER



50 Years of Friendly Service

Beaver No. 3 Ratchet Threader

For Pipe, Bolts, Conduit

Beaver No. 3 Ratchet Threader is a deluxe tool with fully-enclosed ratchet teeth that cannot get gummed-up or mutilated—thus eliminating the danger of serious accidents caused by ratchet slippage.

Die segments square in shape—no weak sections—are easily removable for sharpening and can be inverted for close threading. Ample openings between segments for oiling and chip clearance.

Diehead carrier free—enclosed metal tool-box available extra.

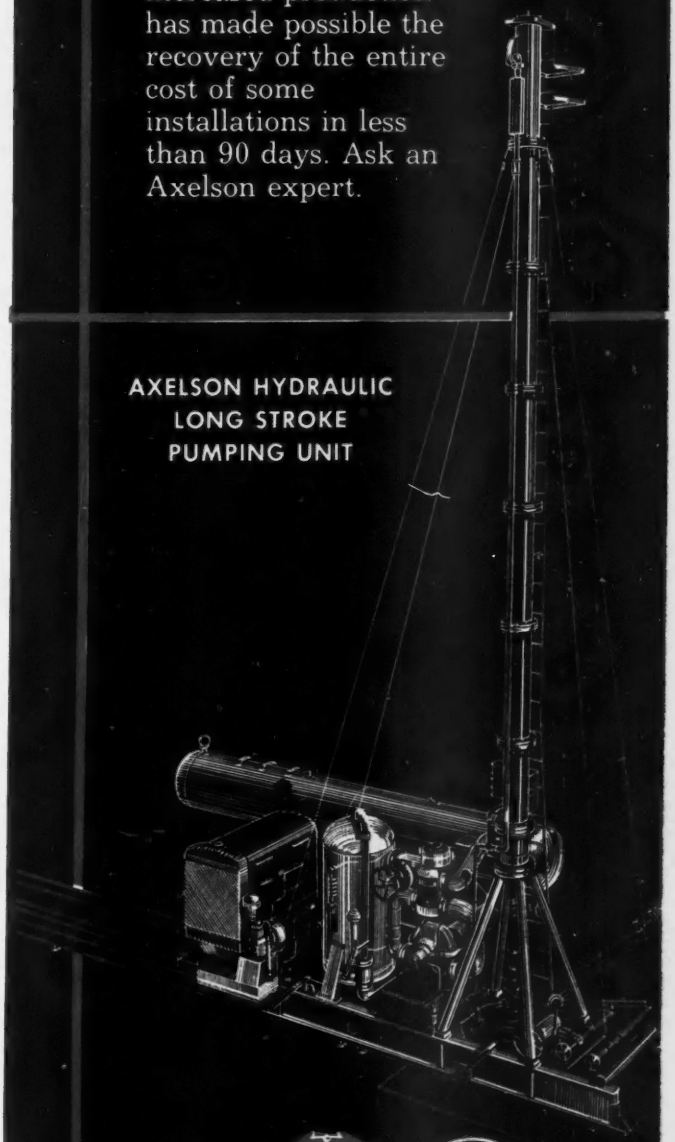
Beaver No. 3 threads Pipe, ⅛ to 1"; Bolts, ¼ to 1"; Conduit, ½ to 1"; Brass Tubing, ¼-20; ⅜ or ¼-27 Thread. Also specials.

Write for complete new Catalog No. 49—free! It shows a complete line of hand tools, ⅛ to 12-inch; electric pipe & bolt machines, power drives, etc. Address Beaver Pipe Tools, Inc., 254-300 Dana Avenue, Warren, Ohio, U.S.A.

BEAVER PIPE TOOLS

90 DAYS... Field reports on Axelson Hydraulic Pumping unit operation show that definitely increased production has made possible the recovery of the entire cost of some installations in less than 90 days. Ask an Axelson expert.

AXELSON HYDRAULIC LONG STROKE PUMPING UNIT



THERE IS NO ECONOMICAL SUBSTITUTE FOR QUALITY

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

AXELSON

First Choice

AXELSON MANUFACTURING CO. • PLANTS—Los Angeles 58; St. Louis 16 • OFFICES—New York City 7; Tulsa 1; Buenos Aires, Argentina; Caracas, Venezuela • DISTRIBUTORS—Jones & Laughlin Supply Co.; Great Northern Tool & Supply Co.; Industrial Agencies, Ltd., San Fernando, Trinidad, B.W.I.; Industries Waldrip & Campbell, Barcelona & Maracaibo, Venezuela; Dominion Oil Field Supply Co., Ltd., Calgary, Canada; South American Supply Co., Avenida Tacna 592, Lima, Peru.

NEW EQUIPMENT

SUPPLEMENTING COMPOSITE CATALOG

Rein Jars

This item supplements The Cavins Company data on pages 1166-1171 of Composite Catalog, 17th Edition.

The new Cavins Rein Jars are made of alloy steel, electric-welded, stress-relieved and heat-treated. The rein sections are milled from solid bar stock, leaving the web an integral part of the parent metal, and the open end of the rein welded to the solid stock, after assembly, on which the joints are cut. Choice of material and its treatment, together with the inclusion of only two points of weld, make this jar capable of withstanding long and rough usage.

Stock sizes are 2-, 2½-, and 2¾-inch outside diameter, with 24-inch stroke. Standard stock join sizes are the same as for the 2-, 2½- and 3-inch O.D. Cavins wire line fishing jars.

For additional information, write The Cavins Company, 2853 Cherry Avenue, Long Beach 6, Calif.

Displacement Meter

This item supplements Rockwell Manufacturing Company data on pages 3581-3612 and 4104-4107 of Composite Catalog, 17th Edition.

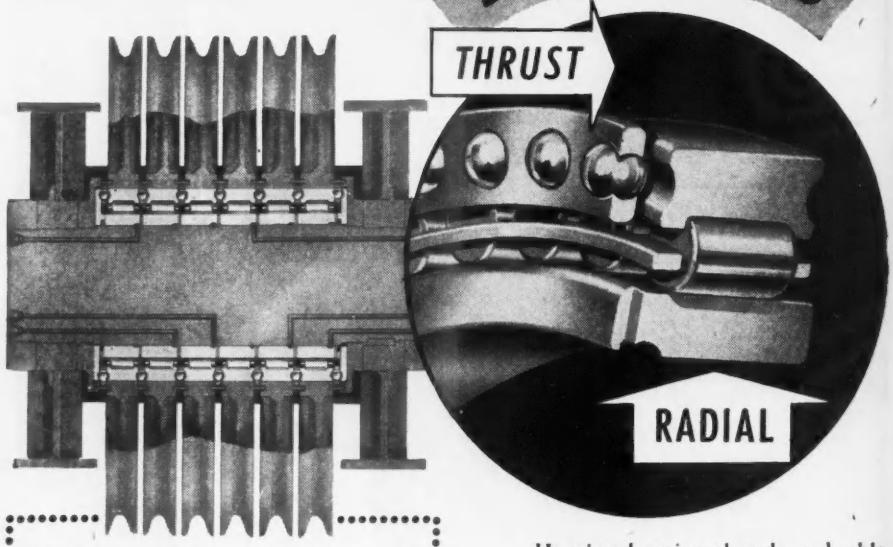
A high-capacity positive-displacement meter capable of handling gas at pressures up to 1000 psi accurately meters wide ranges of delivery of gas at the take-off point. The new meter, the No. 2½ Rockwell, weighs 950 pounds, is encased in high-tensile alloy steel castings with 1¼-inch studs joining the body and cover, and has capacities of 31,000 and 46,000 cubic feet of gas per hour (on a four-ounce basis) at pressure drops of 6 and 10 inches water head respectively. Its index plate carries combination drillings so that standard indexes can be oriented in either of two directions. The cast body is heavily ribbed, and all moving and working parts are supported on a single plate held between body and cover. Outside dimensions are 30⅞ inches between connection flanges, 22¼ inches deep, and 26-15/16 inches high to index plate.

For additional information, write Rockwell Manufacturing Company, Valve and Meter divisions, 400 North Lexington Avenue, Pittsburgh 8.

BEAUMONT CROWN AND TRAVELING BLOCKS

Provide NEW SMOOTHNESS • Narrowness • RUGGEDNESS

WITH THE HELP OF THIS New Aetna 2-WAY BEARING



Application of Aetna's new, patented combination bearing in Beaumont's 6-sheave crown block.

Here's a bearing that does double duty in crown and traveling blocks—handles both radial and thrust loads as pure right angle loads—permits new block compactness that saves space, saves weight, saves money.

This new, patented combination cylindrical roller and ball thrust bearing is designed for use in blocks of any type, with any number of sheaves. Its 2-way, non-interfering load capacity attains lowest possible coefficient of friction, increases radial load capacity, lengthens bearing life, reduces risk of shut-downs, cuts maintenance and replacement costs to a new record low. Write for complete information on this and other Aetna oil country bearings.

AETNA BALL AND ROLLER BEARING COMPANY

4600 SCHUBERT AVENUE • CHICAGO 39, ILLINOIS

Aetna

STANDARD AND SPECIAL BALL THRUST BEARINGS • ANGULAR CONTACT BALL BEARINGS • SPECIAL ROLLER BEARINGS • BALL RETAINERS • HARDENED AND GROUND WASHERS • SLEEVES • BUSHINGS

W.C. NORRIS, MANUFACTURER, INC.

TULSA, OKLAHOMA

WEST COAST DISTRIBUTORS:
REPUBLIC SUPPLY COMPANY OF CALIFORNIA.
Los Angeles

Since QUALITY PRODUCTS 1882

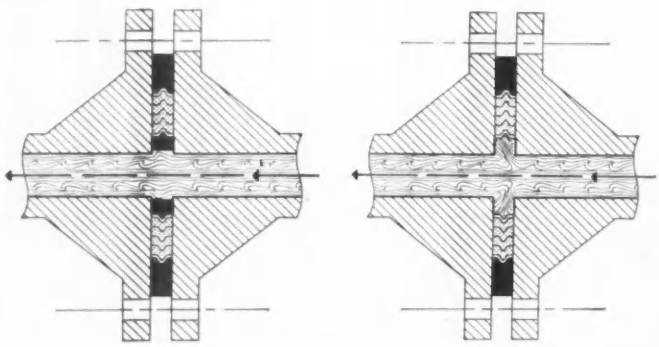
BRANCHES:
HOUSTON, KILGORE, ODESSA, TEXAS;
SALEM, ILLINOIS; CASPER, WYOMING

EXPORT: 30 ROCKEFELLER PLAZA, NEW YORK CITY

OTHER NEW AND IMPROVED EQUIPMENT

High Pressure Gasket

A new high-pressure gasket is designed to streamline jointed connections, reduce turbulence in the piping and increase flow of fluid. It is a compression gauge type with an inside and an outside ring. Called the Style CGI, it has a spiral-wound construction with alternating V-crimped plies of metal and filler. The inside ring converts one of a pair of smooth-face flanges to a groove flange, providing the safety of a wholly-contained gasket. The inside ring provides a compression gauge which supplements the outside ring. It prevents radial movement of the gasket under high bolt loads and minimizes gasket contamination from corrosive fluids. Pressure range is 150 to 2500 pounds. The illustration, left, shows turbulence in flanged joint when sealed with conventional gasket. Drawing at right shows effect of the new gasket, reducing turbulence and increasing flow.



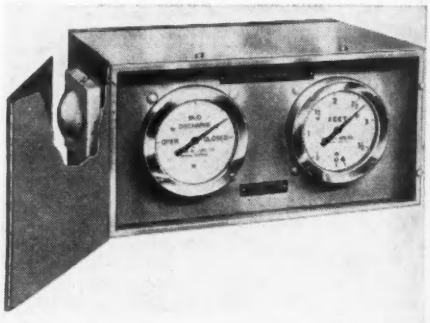
For additional information, write Flexitallic Gasket Company, 8th and Bailey Streets, Camden 2, N. J.

Mud Measuring System

A new system of measuring changes in the mud flow cycle during drilling operations consists of four units: two measuring and two indicating or recording instruments. One measuring unit, the Mud Pit Level Gauge, is in the mud pit near the suction intake. Resting always on the surface of the mud in the pit, the steel float actuates the transmitting mechanism as the mud pit level fluctuates.

The other measuring unit, the Mud Flow Indicator, is attached to the end of the mud return outflow pipe, and has its own transmitting mechanism. As the flow of mud returned to the pit varies, a gate overhanging the end of the pipe swings open or shut, and transmits this measurement to the receivers.

One of the receiving instruments, the Visual Indicator and Alarm, is mounted on the drilling floor, where the driller can see at a glance the condition in the mud pit and at the return outlet. This instrument has two sets of receivers—one connected to the transmitter in the Mud Pit Level Gauge, and the other set to the transmitter at the Mud Flow Indicator.



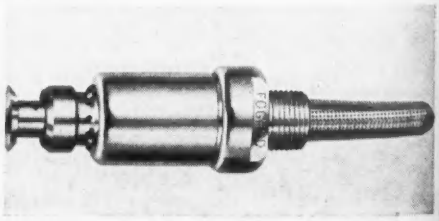
The other receiving unit, the Mud Flow and Mud Level Recorder, is away from the rig so as to be free from vibration. This unit also has two actuating units, which record on a permanent 24-hour chart.

For additional information, write Shand & Jurs Company, 917 Carlton, Berkeley, Calif.

Water Fog Nozzle

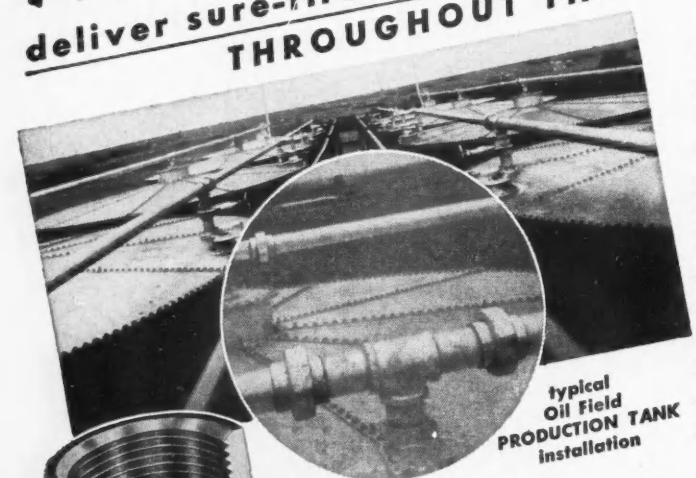
A water fog producing device for use in fixed piping systems of fire protection, using either automatic or manual control or both, is effective in extinguishing first involving materials of low flash point when processes involving high temperatures and pressures are used. Extinguishment is accomplished by cooling burning materials below their vaporization points, or, in the case of certain volatile materials, by the dilution of combustible mixtures by excluding oxygen. The equipment, known as Foghed, is pictured in operating position with jet-impinging orifice.

For additional information, write Fog Nozzle International, a division of Akron Brass Manufacturing Company, Inc., Wooster, Ohio.



CATAWISSA PERFECT SEAL UNIONS

deliver sure-fire piping dependability THROUGHOUT THE OIL FIELDS!



In high or low pressure, extremely high temperature or corrosive piping conditions, CATAWISSA HOT FORGED STEEL UNIONS are maintaining their long-standing reputation for sure-fire piping dependability!

CATAWISSA PERFECT SEAL UNIONS are designed and produced for dependable, long-life service under the severest piping conditions—made with hand ground seats that require no packing and feature Catawissa's Ball-To-Angle seat design which gives a PERFECT SEAL even when the pipe is not in alignment!

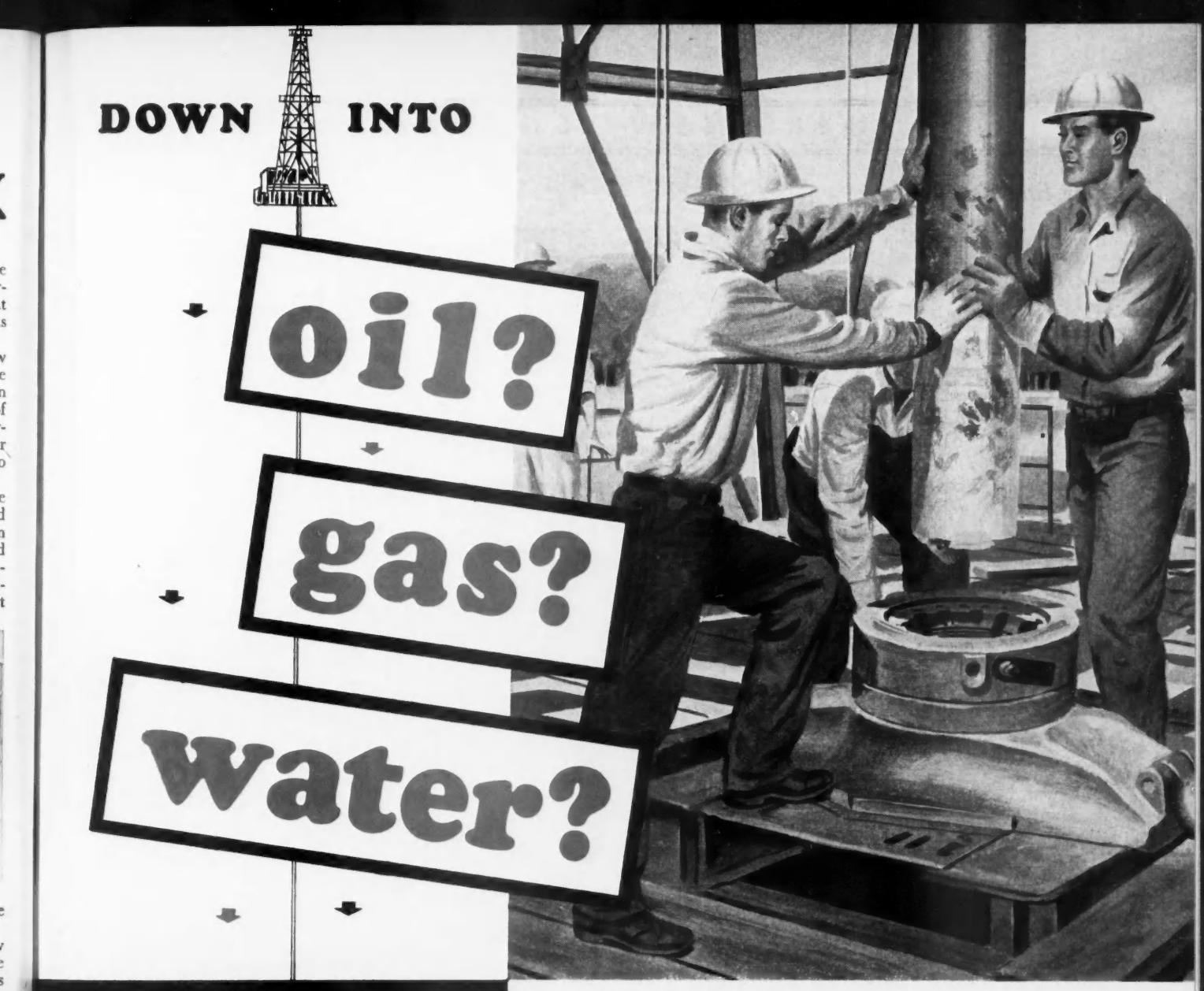
write or call for your copy of the NEW CATALOG 11 showing the complete Catawissa Line

stocked and distributed by

OIL WELL SUPPLY CO.

Branches Serving All Oil Fields

Catawissa Valve & Fittings Co.—Catawissa, Penna.



To know for sure call JOHNSTON

The Johnston Open Hole Tester has again taken a more important place in forming decisions as to whether or not to set casing.

With the cost of casing high and hard to get you can't afford to set casing before you know for sure whether you have oil, gas or water. The unfailing dependability of the Johnston Open Hole Tester will give you that information.

Experienced Johnston service men are available in all active areas ready to serve you twenty-four hours a day.

JOHNSTON OIL FIELD SERVICE CORP.

5702 NAVIGATION BOULEVARD — HOUSTON, TEXAS

TEXAS—Houston, Alice, Cisco, Graham, Throckmorton, Wichita Falls, Tyler, Victoria, Bowie, Jacksboro, Kermit, Odessa, San Angelo, Snyder, McAllen, Abilene, Gainesville, Midland. INDIANA—New Harmony. KANSAS—Great Bend, Plainville, Wellington. LOUISIANA—Houma, Lake Charles, Shreveport. MISSISSIPPI—Brookhaven, NEW MEXICO—Hobbs. OKLAHOMA—Chickasha, Elk City, Healdton. ARKANSAS—Magnolia.

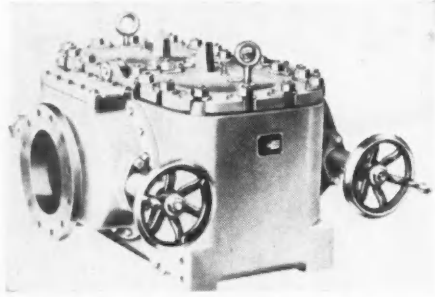
M. O. JOHNSTON OIL FIELD SERVICE CORP.

Servicing California, Rocky Mountains & Canada

FORMATION AND CASING TESTING — JOHNSTON

Duplex Strainer

High rates of flow, with low pressure drop from input to outlet, result from the angle design of the new Gate Type Duplex Strainer applied to multiple catch-baskets which permits straight-through flow. When baskets are 90 percent blocked, pressure drop increases only 44 percent. Strainers are fitted with hinged top covers and multiple strainer baskets, to allow cleaning by one man. The operating screw is sealed from fluids inside the strainer, and covered by a heavy housing. The free-floating bronze valve discs insure against binding of the valve mechanism, and are removable

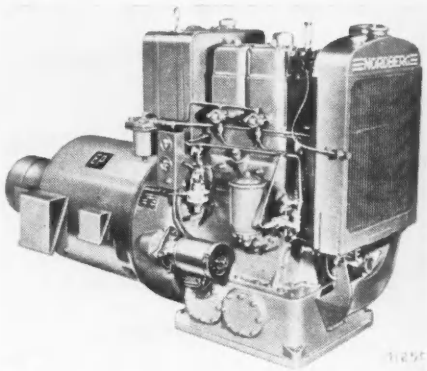


through access covers. The strainers are available in sizes from 8- to 24-inch, to handle flow rates from 400 to 15,000 gallons per minute.

For additional information, write J. A. Zurn Manufacturing Company, Everett and Pittsburgh Avenues, Erie, Penn.

Diesel Engine

A two-cylinder engine to supplement the Type 4FS1 single-cylinder, 10 to 15 horsepower diesel engine, is rated at from 20 to 30 horsepower. It has an operating speed range of 1200 to 1800 rpm, a 4½-inch bore and 5¼-inch stroke, and is an extra heavy-duty, vertical, four-cycle, mechanical injection diesel engine. Known as the 4FS2, the engine is offered as an electrical generating set, pumping unit, and with clutch or stub shaft power take-off for direct connection or belt drive. It is also available for marine auxiliary applications. Pictured is the 4FS2-CE gener-

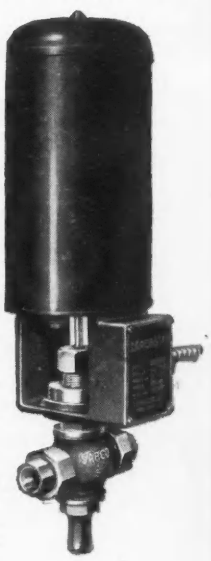


ating unit for stationary and portable power applications and marine auxiliary use, ranging from 12 to 20 KW, direct or alternating current, 50 or 60 cycle.

For additional information, write Nordberg Manufacturing Company, Chase and Oklahoma avenues, Milwaukee 7.

Hydraulic Motor Valve

An electro-hydraulic motor valve for open-and-shut control is two-wire, normally closed, for direct connection to 110 volts a-c, 60-cycle current. It is designed for automatic operations by thermostats or pressurestats or by liquid level or flow controls. As a shut-off valve in an inaccessible location, it can also be actuated by a push-button. The Sarcostat valve will handle steam, water, oil, gas, air, etc.



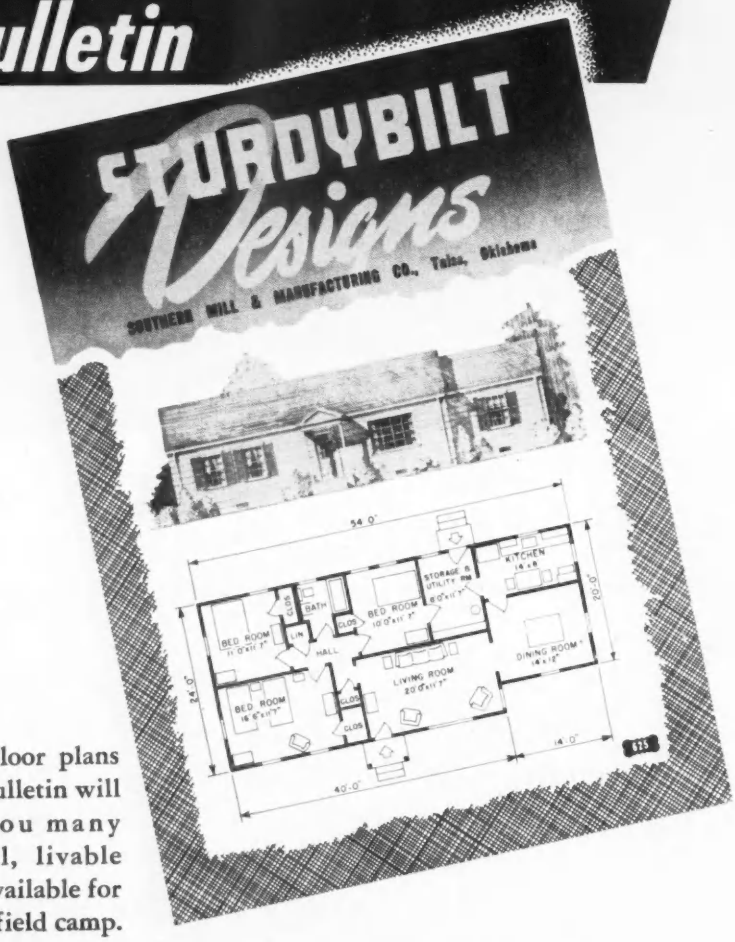
The valve operator, actuated by hydraulic power, operates single seated valves up to 1½-inch, or double-seated valves up to 4-inch at 125 psi. When the full stroke is used, standard valves open in 60 seconds and close in 10 seconds.

For additional information write Sarco Company, Inc., 350 Fifth Avenue, New York 1.

Write for this FREE HOUSE PLANS Bulletin

STURDYBILT Designs

SOUTHERN MILL & MANUFACTURING CO., Tulsa, Oklahoma



• The floor plans in this bulletin will show you many practical, livable homes available for your oil field camp.

MANUFACTURERS OF SPECIAL MILLWORK, DISTRIBUTORS OF JOHNS-MANVILLE BUILDING MATERIALS; CURTIS WOODWORK

STURDYBILT

SOUTHERN MILL & MANUFACTURING CO.

Tulsa, Oklahoma

Prefabricated, Demountable Houses

PREFABRICATED HOME MANUFACTURERS' INSTITUTE phmi

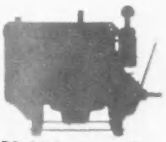
STURDYBILT HOUSES COMPLY WITH COMMERCIAL STANDARD CS125-45 OF THE NATIONAL BUREAU OF STANDARDS FOR PREFABRICATED HOMES

"LOWEST COST pumping operation I know of," says L. M. Lott, pumper for J. B. Daniels, Fairfield, Texas.

Pumps for Pennies

International U-6 pumps 59,904 hours on Texas well.

Cost of lubricating oil and replacement parts only 4/5 cent per hour!



This is no Texas "brag!"

This is fact: J. B. Daniels, Fairfield, Texas, has used this International U-6 on a pump jack for 59,904 pumping hours. Fuel is waste natural gas. The only expenses—lubricating oil and repair parts—cost only four-fifths of a cent per hour.

That's the economy of International power. Here are more reasons to buy: Smoothness of multi-cylinder operation, built-in endurance and adaptability. Service facilities throughout the oil fields. And if you buy on reputation—mister, you'll buy International!

International Harvester Company, Chicago 1, Illinois

POWER THAT PAYS

INTERNATIONAL HARVESTER

INTERNATIONAL

INTERNATIONAL HARVESTER COMPANY
P. O. Box 7333, Chicago 80, Ill.

Please send me a copy of your catalog, A-384-NN International Oil Field Pumping Engines.

Name_____

Address_____

City_____ Zone____ State_____

High Temperature Alloys

Two new cobalt-base alloys are described in a revised edition of the booklet, "Haynes Alloys for High-Temperature Service." The booklet contains 96 pages of technical data on ten alloys. A section on each alloy gives a general description of the material recommended uses, chemical composition and physical and mechanical properties, in tabular and graphic form. Nine pages of graphs compare the mechanical properties of the various Haynes alloys. Age-hardening data and fabrication procedures are also included.

For a copy of this booklet, write Haynes Stellite Division, Union Carbide and Carbon Corporation, Kokomo, Ind.

Plastic Packings

Garlock packing and gasketing materials made of "Teflon," the DuPont tetrafluoroethylene resin, are described in a new folder.

For a copy of this folder, write The Garlock Packing Company, 250 Main Street, Palmyra, N. Y.

Type "XV" (Extra Volume) King Swivels

For Circulating Large Fluid Volumes

Be Sure IT'S A KING *Be Safe*

Type "XV" King Swivels are designed specifically for drilling conditions where the circulation of greater quantities of drilling mud is required than can be handled by conventional models of small swivels.

In addition to oversize watercourses, King Type "XV" Swivels provide many exclusive features that make them the first choice everywhere for Water Well Drilling, Geophysical Drilling, Working Over, Drilling Shallow Oil Wells, Core Drilling, Drilling in and Coring with Reverse Circulation.

Check these outstanding advantages you get with King Type "XV" Swivels:

- OVERSIZE WATER COURSES assure Large Fluid Volume.
- MOULDED RUBBER PACKINGS ELIMINATE the stuffing boxes.
- HARDENED WEAR-BUSHINGS eliminate the washpipes.
- THE PACKING AND WEAR-BUSHINGS can be renewed within a very few minutes without removing any other part from the swivels.
- ANGULAR-CONTACT BALL BEARINGS provide ample thrust capacity and insure radial stability.
- ALLOY STEEL CONSTRUCTION assures safety with minimum weight.
- SHORT, COMPACT DESIGN requires less room in the derrick.
- STREAMLINED—no projections to "hang up."
- CLOSED HOUSING PROTECTS THE BEARINGS.
- LUBRICATION, of BEARINGS, is by means of a grease gun.

This swivel fulfills a long felt need of the well drilling fraternity.

See your latest Composite Catalog for other King Oil Tool products.

KING OIL TOOLS

210 TERMINAL STREET PHONE OS 3-3421

HOUSTON 20, TEXAS

EXPORT: R. S. STOKVIS & SONS, INC.

17 BATTERY PLACE, NEW YORK 4, N. Y.

Air Pumps

How air pumps operate and where they are used effectively are described in a new catalog. Performance curves and specification tables on four-wing and two-wing type air pumps and accessories are included. Leiman air pumps are of the rotary positive type, for vacuums up to 29 inches and pressures up to 25 psi.

For a copy of Catalog 450, write Leiman Bros., Inc., 69-F Christie Street, Newark, N. J.

Rust Prevention

The problem of industrial rust prevention is discussed in a new catalog on Rust-Oleum, which describes application methods for different kinds of service. At least 70 color chips are included in the catalog, and complete specifications are presented.

For a copy of this catalog, write Rust-Oleum Corporation, 2431 Oakton Street, Evanston, Ill.

Welding Torches

"How to Weld with Heliarc Torches" is a revised 28-page booklet with information on welding, surfacing and hard-facing of many commercially used metals. Described are the fundamentals of the process, Heliarc equipment, preparations for welding, operating instructions, and welding data for various metals.

For a copy of booklet F-6190, write The Linde Air Products Company, 30 East 42nd Street, New York 17.

Oil Field Power

Diesel engines that operate on the same crude oil they pump are described in an eight-page, illustrated booklet, "Power for Your Oilfield Job." The brochure covers a diesel that has pumped oil for more than 12 years on a 24-hour schedule, engines that operate on natural gas, and diesels for portable rigs.

For a copy of Form 12935, write Caterpillar Tractor Company, Peoria 8, Ill.

Protective Paint

A 12-page bulletin on Tygon corrosion-resistant paint tells where and how to use the paint and where not to use it. Corrosion resistance tables, based on field experience, are included.

For a copy of bulletin 712, write U. S. Stoneware Company, P. O. Box 350, Akron 9, Ohio.

Corrosion-Proofing

A new technical bulletin describes the steps in applying Prufcoat Metal Reactive Primer P-10 and "A" Series Prufcoat for corrosion-proofing ferrous and aluminum surfaces. A question-and-answer section is included.

For a copy of bulletin 012, write Prufcoat Laboratories, Inc., 63 Main Street, Cambridge 42, Mass.

FOR ONE JOB *well done!*

The one and only job of a centralizer is to keep casing centered in the hole under every condition whether rotating, reciprocating or stationary.

The Larkin Centralizer has passed every on-the-job test wherever it has been used. Accordingly, it is recognized everywhere as the most positive centering tool available.

- All 10 of the staves work as a unit, providing a centering strength many times greater than the conventional Centralizer.
- Casing may be rotated without rotation of the Centralizer.
- It provides a greater peripheral bearing on the wall of the hole. The staves are staggered to give 10 points of contact.
- The original "Tailor-Made" to hole size Centralizer. No on-the-job adjustments necessary.

LARKIN

...Through Your Supply Store

LARKIN PACKER CO., INC. • St. Louis, Mo.

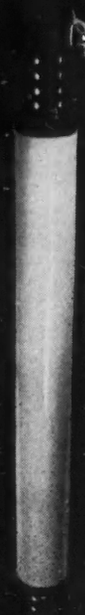
L-O-N-G-E-R
THREAD LIFE

1. EXCLUSIVE 500-TON SPECIAL prevents washouts and galling. Makes breaking out easier; withstands highest pressures, and is unaffected by heat and moisture!
2. KANT-GALL TOOL JOINT COMPOUND
3. LONG-LIFE DRILL COLLAR COMPOUND

SOLD BY SUPPLY STORES EVERYWHERE

PETROLEUM DISTRIBUTING CO.
BOX 203—HOUSTON, TEXAS
Charter 5648

PARELEX
Electric Heaters
for
Oil Wells
Bottom Hole Tubing and Flowline Heaters for Paraffin and Heavy Crude
Write for Details


Model BH3

PARELEX CORPORATION
2615 FANNIN STREET
HOUSTON 2, TEXAS

Men in the Industry NEWS

F. B. Plank

M. A. Wilson

F. B. Plank of Bartlesville, Okla., has been elected a director, vice president and secretary of Cities Service Oil Company (Del.) and Cities Service Pipe Line Company, succeeding **C. E. Murray,** retired after nearly half a century with the Cities Service organization. Plank has been with Cities Service since 1918 specializing in tax matters. He served several years as general chairman of the Standing Committee on Federal and State Income Taxes of the Mid-Continent Oil and Gas Association and is now chairman of the Special Depletion Committee of that association.

M. A. (Woody) Wilson, Bartlesville, has been elected comptroller of Cities Service Oil Company (Del.), Cities Service Pipe Line Company and other Bartlesville-affiliated companies. Joining the Cities Service organization in 1916 he has served as bookkeeper, auditor, assistant general auditor, general auditor and asistant secretary of Cities Service Oil Company and the Bartlesville-affiliated companies.

•

Sam H. Casey has been promoted to assistant to **R. J. Diwoky,** executive vice president of Pan-Am Southern Corporation, and has moved from Shreveport to the New Orleans office. In July, 1948, Casey became manager of Crude Oil Purchasing department of Root Petroleum Company, which later merged into Pan-Am Southern Corporation. Prior to his services with Root, he was with Sohio Petroleum Company as district representative for the Crude Purchasing department in Shreveport. He had held a similar position in the Illinois, Indiana and Kentucky area, and had been manager of Personnel and Industrial Relations department in St. Louis for Sohio.

John E. Brewster was promoted to assistant manager of the Crude Oil Purchasing department of Pan-Am Southern, and will assume the duties formerly handled by Casey. Brewster was graduated from Arkansas A. and M. College at Monticello, Ark. After serving 32 months in the Army Air Force in the China-Burma-India area, he began work with the Root Petroleum Company in the Pipe Line department at El Dorado, later being promoted to engineer in the pipe line and producing operations. January 1, 1950, he was transferred to Shreveport as assistant to Casey.

•

J. T. Durkee has been appointed Comptroller of the General Petroleum Corporation. A veteran of 31 years with General Petroleum, Durkee has been assistant comptroller and assistant treasurer since 1938. In his new post he will assume some of the responsibilities of **Wesley Cunningham,** treasurer of General Petroleum and a member of the board of directors, to whom Durkee will continue to report.

In the new personnel alignment of the Comptroller's department, **H. D. Osborn** continues as assistant comptroller. Two new assistant comptrollers have been appointed. They are **Gordon D. Campbell** and **Howard W. Wilson.**

A native of Scotland, Campbell joined General Petroleum in 1923. He has been in charge of the company's oil and gas accounting sections for 13 years.

Wilson has been manager of the accounting department since 1949, and will continue to be in charge of general accounting for the company. He has been with General Petroleum since 1926.

•

Herbert Hoover, Jr., president and general manager of United Geophysical Company, and United Geophysical Company, S. A., was elected to the board of directors of Union Oil Company of California. Hoover was elected to fill the vacancy caused by the death of **Ernest Stauffen,** who had been a member of Union's board for six years. Hoover will continue as the active manager of the United Geophysical Company.

Herbert Hoover, Jr.

Hoover, who organized United Geophysical, received his A. B. degree at Stanford University and his M. A. degree at Harvard.

•

Castle J. Harvey has been appointed manager of the Deep Rock Oil Corporation's Geophysical department. A 1932 graduate of the University of Illinois, in 1935 he joined Amerada Petroleum Corporation's Geological department and for eight years did scouting and development and regional geology in Oklahoma, Texas and Louisiana. He joined The Atlantic Refining Company in 1943 and held successively the jobs of geophysical coordinator at Tulsa, geophysical supervisor first for Oklahoma and Kansas then for Mississippi, Alabama and Florida and geologist for northern Oklahoma before moving to Deep Rock.

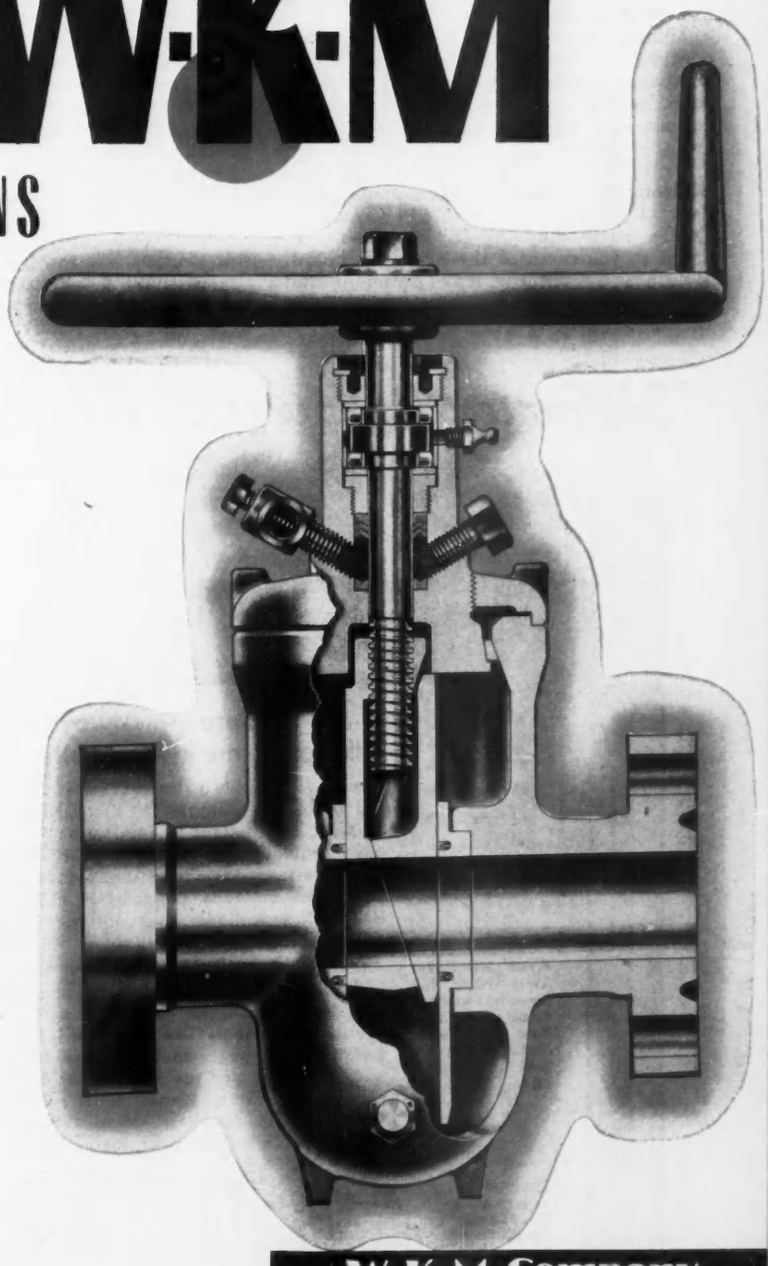
Standco
NO-SMOKE
STANDCO BRAKE LINING
For the easiest brake known. It feeds off evenly. Standco never scores brake rims. See Pages 3608-3613 Composite Catalog.
Standco Brake Lining Co.
HOUSTON

WHY BUY W-K-M

HERE ARE 9 GOOD REASONS FOR W-K-M GATE VALVE *Superiority*

W-K-M high pressure Gate Valves for flow lines and Christmas Trees have earned their place as the most dependable . . . and the most popular . . . valves in oilfields throughout the world. That's why hundreds of operators have standardized on W-K-M Valves.

1. **Through-conduit opening . . . no turbulence . . . no restriction of flow.**
2. **Parallel expanding gates . . . seal directly across both seats with no distortion whatever . . . positive shut-off on both sides.**
3. **Lubricant contained in entire body . . . no special lubricant required . . . seal does not depend on lubricant.**
4. **Oversize bronze renewable seats.**
5. **Combination wipe and seal rings keep the gate clean . . . pressure out . . . grease in.**
6. **Double roller thrust bearings on stem for ease of operation.**
7. **Combination plastic-chevron packing . . . uses no gland or gland follower.**
8. **Pressure seal bonnet . . . no flanges, no studs and nuts.**
9. **Every W-K-M Valve is backed by a sales and service organization covering the world.**



W-K-M Company

OIL FIELD, PIPE LINE & INDUSTRIAL EQUIPMENT

HOUSTON, TEXAS, U. S. A.
LOS ANGELES

Cable Address: "WILKOMAC"
Export Office: 30 Rockefeller Plaza, New York, N. Y.

A. A. Stambaugh

A. E. Wolf

Armstrong A. Stambaugh, senior vice president of The Standard Oil Company (Ohio), has been elected chairman of the board. **Alfred E. Wolf,** vice president in charge of finance and secretary of the company, has been made a director of the company. The elections were occasioned by the death of W. T. Holliday, chairman of the board.

Stambaugh, who has been with Sohio continuously since 1928, will conduct the company's public and industry relations, coordinate internal and external communications, and consult on general sales policies.

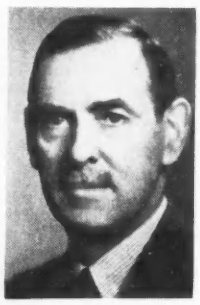
•

Malcolm E. Wilson has been made president of General American Oil Company, Dallas, succeeding **A. H. Meadows,** elevated to chairman of the executive board. Wilson was executive vice president and is succeeded by **Gordon Simpson,** who also retains his post as general counsel.

H. J. Struth, petroleum consultant, Dallas, has been retained by the Venezuelan government as economic adviser on petroleum, on annual contract basis. He recently returned from Caracas after completing the first Annual Report on the Petroleum Industry for the Venezuelan government, which now is being printed in the U. S.

•

G. W. Dunkley has been appointed an executive director of the Iraq Petroleum Company and associated companies. Dunkley entered the London office of Anglo-Persian Oil Company in 1914. He joined Iraq Petroleum in 1931 as the company's agent in Iraq, Palestine, Transjordan, Syria and Lebanon. In March, 1935, he was appointed general manager in the Middle East, and was transferred to the London office shortly before the outbreak of the war. He was in government service during the war, and in 1944 rejoined the company as a member of the management in London.



G. W. Dunkley

•

Bill Cordell has resigned as district manager for Sohio Petroleum Company at Shreveport, to become a consulting geologist with Dan Kralis at Abilene, Texas.

D. F. Sears has been promoted to assistant to the president of Shell Pipe Line Corporation in Houston. He is also a director of the corporation.

A. F. Terrill, who has served as acting area superintendent in both the West Texas and Texas Gulf areas, has been promoted to West Texas area superintendent, with headquarters at Colorado City, Texas.

Sears joined the company at St. Louis in 1927, in 1933 was named assistant to the manager, and in 1939, general superintendent and assistant secretary. During the war he was chief of the Pipe Line section, Supply and Transportation division, PAW. In his new assignment he will act as project coordinator for design and construction of the 162-mile 30-inch pipe line from Maracaibo to Paraguana Peninsula in Venezuela, being managed by the Shell Pipe Line staff to assist Shell Caribbean Petroleum Company.

Terrill has had more than 30 years' service with Shell, and has held positions in all three operating areas and in Shell Pipe Line's head office.

•

Grover E. Murray, professor of geology at Louisiana State University, has been appointed chairman of the Department of Geology. **H. V. Howe,** who has been head of the department since 1922, continues as director of the School of Geology.

•

E. R. Baker has been promoted from manager of Continental Oil Company's Central Research Laboratories to assistant manager of the Development and Research department, Ponca City, Okla. Manager of the department is **L. L. Davis.** Baker, who joined Continental in 1948 as manager of the laboratories, during World War II served under the late **Brig. Gen. W. C. Kabrich** as assistant chief of the Technical division of Chemical Warfare, now known as the Chemical Corps.

E. R. Baker

Four promotions in Continental Oil Company's western region headquarters at Los Angeles have been announced. **Olen Lane,** formerly regional manager of exploration, has been promoted to the newly-created position of assistant regional manager. **R. M. Barnes** has been promoted from regional geologist to regional manager of exploration; **J. B. Anderson,** from assistant regional geologist to regional geologist; and **R. M. Smith,** from geologist to the newly-created position of assistant to the regional geologist.

Lane joined the company as a leaseman at Los Angeles in 1922 and has remained in that region since. He became regional manager of exploration early this year.

Barnes, Anderson and Smith also joined Continental in Los Angeles in geological position.

•

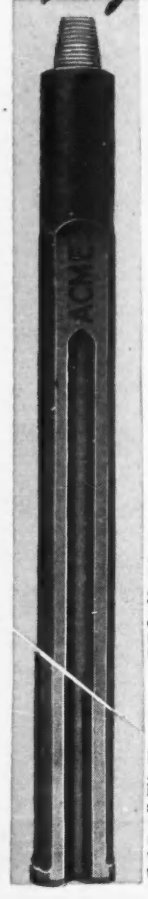
W. C. Osborne has resigned from Tide Water Associated Oil Company to become chief geologist for Union Sulphur and Oil Corporation at Shreveport.

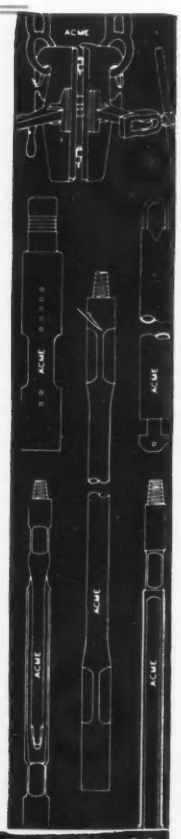
"The Greatest Name in Cable Tools..."

Acme

TRUSTWORTHY SINCE 1900

PETROLEUM EQUIPMENT SUPPLIERS' ASSOCIATION MEMBER





. . . to-be-Sure — Always Ask for Acme's Alloy Bits...

A most reasonable extra FIRST cost buys you ½-century's biggest bit buy. Delivers 50% or more actual in-hole action than any "regular" bit. Acme "Drilmor" ALLOY meets the increasing demand for a new type bit fully capable of cutting HARDEST formations; assuring more in-hole time.

Another feature (saving wasted out-time) is that Acme's Alloy Bit can be dressed and tempered in the field. And without special equipment; like "regular" bits. EXTREME, deeper penetrating hardness makes Acme's non-competitive Bits hold cutting edge, wear longer, resist battering, even in toughest going. They're longer life bits. for your longer profit.

Write NOW for Alloy Bit's full facts and your copy Acme's latest Cable Tool Catalog — containing proper field treatment of bits.

Fig. 108AA. Acme Alloy Bit. 51-years' specialized "know-how" makes it worth more to YOU.

ACME DRILLING & FISHING TOOLS

ACME FISHING TOOL CO.
PARKERSBURG W. VA.
Export Office:
19 Rector St., New York 6, N.Y.

MEN IN THE INDUSTRY NEWS

Roy R. Morse

W. F. Bates

Dr. Roy R. Morse, regional director of exploration for Shell Oil Company, Houston, has retired after 26 years of service with the company. Dr. Morse joined Shell in California in January, 1925, and was transferred to the company's Houston office in 1935 as exploration manager. In 1944 he was named manager of the Texas Gulf area, with responsibility for general planning and coordination of the exploration, production and land departments. In November, 1946, he became director of exploration for the company's East-of-the-Rockies region, a post he held until his retirement.

Dr. Morse received a B. S. degree from the College of Mines, University of California, in 1913, and a Ph.D. from the same university in 1923.

With the retirement of Dr. Morse **Floyd A. Nelson,** regional geologist, will supervise activities of the company's regional exploration staff. A 1924 graduate of the University of Wisconsin, Nelson joined Shell in 1929 as an assistant geologist in the St. Louis office. He was transfered to Houston in 1940 as geologist for the company's former Texas Gulf area, and when Shell organized a regional staff for the East-of-the-Rockies territory in 1945, he became regional geologist.

W. F. Bates has been appointed general drilling superintendent of Shell Oil Company, Los Angeles. He replaces **C. S. Penfield** who retired the first of the year after more than 35 years with Shell.

Bates was graduated from Stanford University in 1933 in engineering and joined the company soon afterwards as a roustabout. Two years ago when Shell announced the successful completion of a deep-well portable drilling rig, Bates was in charge of the project. He has had wide experience in all phases of oil field operations, specializing during the past few years in drilling operations.

E. W. Jenkins, superintendent of Shell's Northern district pipe lines with headquarters at Corral, near Tracy, Calif., has retired after nearly 35 years with Shell. **F. B. Jensen,** formerly superintendent of the Southern district pipe lines, succeeds Jenkins at Tracy. Jensen started with Shell in 1926 as a rodman and after gaining wide experience in pipe line operations, was appointed superintendent of the southern district pipe lines in 1947, from which position he moves to Corral.

H. H. McQueen succeeds Jensen as superintendent of the Southern district pipe lines with headquarters in Los Angeles. McQueen joined Shell in 1926 as a draftsman. He was made senior mechanical engineer in Los Angeles in 1944, which position he has held until the present promotion.

WHAT'S AHEAD for the oil industry?

What's the outlook for production in 1951?
How many wells will be drilled? Where?
What about imports? Exports?
How many wells will go on pump?
How much pipe line construction ahead?

you'll find the answers in the

Review-Forecast Issue

WORLD OIL

FEBRUARY 15, 1951

In this special issue of WORLD OIL, you'll find the answers to many of the questions now cropping up about the year 1951. Every phase of the oil producing business will be **reviewed** and **analyzed.** And through the aid of hundreds of oil men all over the country, our editors have been able to establish **dependable forecasts** on what to expect during the year ahead.

This issue, graphically illustrated with tables and charts, brings you important information on oil supply, demand, imports, exports, prices, production, reserves and an outlook on legislation affecting the oil industry. The REVIEW-FORECAST Issue will be sent to our subscribers as a part of our regular service. But if you are not now a reader of WORLD OIL—or if your subscription is about to expire—you can be sure of your copy by sending us the coupon below—today.

Reserve Your Copy Now By Mailing This Coupon

WORLD OIL ☐ New Order
P. O. Box 2608, Houston 1, Texas ☐ Renewal
Enter my subscription to WORLD OIL for the following period:
☐ 1 Year—$2. ☐ 2 Years—$3. ☐ 3 Years—$4.

Name _____ Position _____
Company _____
Street & No. _____
City _____ Zone ____ State _____
We're engaged in:
☐ Exploration ☐ Production ☐ Service ☐ Manufacturing
☐ Drilling ☐ Pipe Line ☐ Suppy ☐ _____
☐ Remittance enclosed ☐ Bill me later

Ben C. Belt, vice president of Gulf Oil Corporation and Gulf Refining Company, Houston Production division, has made the following division staff appointments: **B. G. Martin,** executive assistant and exploitation advisor; **G. B. Lamb,** exploration advisor; **E. B. Tilley,** service advisor; **D. S. Scott,** executive secretary; **C. W. Lutz,** economic advisor; **T. R. Bibee,** employe relations advisor; **J. S. Trail,** fiscal advisor; **E. N. Foster,** purchasing advisor; **P. A. Robertson,** reserves advisor; **Paul Weaver,** special assistant for technical studies; **D. N. Hendricks,** special assistant for statistical studies.

Belt also announced the establishment of the Gulf Coast district of the Production department with headquarters at Houston in lieu of the district formerly called the Houston district. This new district will continue under his jurisdiction with **N. C. Simpson** as general manager, and with the following staff and line personnel: **R. A. Payne,** district exploration advisor and district manager of exploration; **E. P. Hubbard,** district exploitation advisor and district manager of exploitation; **C. B. Hussey,** district services advisor and district manager of services; **J. B. Victery,** assistant general manager; **T. L. Lewis, Jr.,** district employe relations advisor; **K. L. Reiney,** district fiscal advisor; **H. A. Rankin,** district joint interest advisor; **R. V. Cruce,** district reserves advisor; **E. L. Petree,** district superintendent of production; **P. B. Leavenworth,** district chief geologist; **Douglass Lanier,** district superintendent of land and leasing; **G. H. Lacy,** district chief civil engineering. With the establishment of the Gulf Coast district, Simpson with his staff and line assistants will supervise the producing activities of the company in the district, which supervision has heretofore been exercised by Belt and his staff.

The Shreveport district of the Production department, reporting to the vice president at Houston, will continue under the direction of **J. T. Goodman** as general manager.

•

George W. Murphy, Jr., British-American Oil Producing Company, has been promoted from junior petroleum engineer, Oklahoma City, to petroleum engineer, southern district, and transferred to Houston, replacing **R. P. Dunkerly.** Murphy is a graduate of Oklahoma A. and M. College. He joined British-American two years ago and has since been doing engineering work in Wyoming and the Oklahoma City area.

G. W. Murphy, Jr.

•

Alexander Clarke, Jr., has been named division engineer for Stanolind Oil and Gas Company's North Texas-New Mexico division. Clarke, formerly assistant division engineer, succeeds **R. W. Collins,** resigned. Clarke received a B. S. degree in petroleum engineering from Texas A. & M. College in 1940 and joined Stanolind in May of that year.

Succeeding Clarke as assistant division engineer will be **T. M. Curtis.** Curtis was formerly district engineer for Stanolind in Midland and he has been with the company since 1941. He received a B. S. degree in petroleum engineering from the University of Texas in 1939.

J. C. McCarthy has been named district engineer at Midland, replacing Curtis. McCarthy moves to Midland from Tulsa where he was petroleum engineering supervisor in Stanolind's general office. He joined Stanolind in 1940 after receiving a B. S. degree from Pennsylvania State College in 1939.

•

H. S. McQueen has joined Salt Dome Production Company, Houston, as executive vice president and chief geologist. McQueen, a graduate of the University of Missouri, served for many years as assistant state geologist of Missouri. For the past eight years he has been with Alcoa Mining Company as chief geologist, and recently has been in charge of exploration for gas reserves for Alcoa's reduction plant at Port Lavaca, Texas.

H. S. McQueen

This Ton-Mile Indicator Helps You Avoid Overloading Your Rotary Lines...

The best of drillers misjudge the point of overload sometimes. Just one fishing job can mar a top drilling record and run up cost.

Many drillers are turning to work analysis methods to establish the correct time for line cut-off all the way from top to bottom of the hole.

It's not difficult to do and it pays off in lower ultimate rope costs and more efficient rig operation. All you do is set the figures from your log book on the Union Wire Rope Ton-Mile Indicator. It does all the complicated figuring and gives you an accurate measure on the work in ton-miles which your rotary line has done at any point. Send the coupon for your set now. Prove to your own satisfaction that Tuffy Rotary Lines deliver more ton-miles at the ultimate low cost.

It's Easy To Order Tuffy Jackknife or Standard Rotary Lines

Tuffy **Jackknife** Rotary Line is designed to move at higher speeds over the smaller sheaves and drums of the jackknife rig. Tuffy **Standard** Rotary Line is designed for standard rigs. These lines are easy to order. Just specify Tuffy **Jackknife** or **Standard** Rotary line, the length and the size.

MAIL THIS COUPON NOW

union Wire Rope corporation

Gentlemen: Please have a Union Fieldman deliver my Ton-Mile Indicator and Union Log Book and explain its use.

UNION WIRE ROPE CORPORATION
2104 Manchester Ave. Kansas City 3, Mo.

Firm Name .....

Address .....

City ..... Zone..... State .....

Paul E. Haralson has been advanced to superintendent of Magnolia Petroleum Company's Land Department, to succeed the late **Ralph Talley.**

Paul E. Haralson

G. M. Andreen, who has been a petroleum engineer in Magnolia's Vanderbilt Producing district, was promoted to petroleum engineer II and transferred to the company's general office in Dallas. He is assigned to the Proration section of the Petroleum Engineering department.

Glen W. Barb, who has been petroleum engineer assigned to the Louisiana-Gulf district, Morgan City, La., has been transferred to the Vanderbilt district as a petroleum engineer.

•

Roy Alston has been named administrative assistant to **J. Howard Marshall,** president, Ashland Oil and Refining Company.

•

Louis W. Storms, Jr., has been elected president of Pantepec Oil Company, C. A., and its affiliate, Pancoastal Oil Company, C. A., with headquarters in Caracas, Venezuela. Storms, a petroleum engineer and production specialist, was with Creole Petroleum Corporation for five years, and before that was with Sandard Oil Company (N. J.) affiliate for 18 years. He also served with the PAW in Washington, D. C.

Storm succeeds **F. H. Bailly,** who has resigned to devote more time to the management of Petroleum Consultants, Ltd., of Pasadena, Calif. Bailly remains with Pantepec in a consulting capacity.

•

Ray Staples has become a partner in the firm of Cable & Stine, petroleum engineers, Wichita Falls, Texas. Staples, who has been with the firm since 1944, was formerly employed as a petroleum engineer in charge of production of a water-flood project in Southeastern Kansas, and later as a petroleum engineer with the U. S. Department of the Interior in Oklahoma.

Ray Staples

At Cable & Stine he is in charge of the core analysis lab, salt water disposal, and water-flood surveys and installations.

•

Sam L. Lewk has retired as head of rentals and records, Leasing department of the Land division, Shell Oil Company, Tulsa area, and will become an independent oil operator.

•

David Murphy, treasurer of Saltmount Oil Company, Denver, has been elected president of the company and of Mountain Producers, an affiliate, succeeding **H. D. Herndon,** San Antonio, resigned.

Homer B. Williams, formerly with Sun Oil Company in Dallas, has joined Houston Oil Company of Texas and Houston Pipe Line Company as tax commissioner. He succeeds **C. P. Rogers** who has retired after 20 years of service with the companies.

H. A. Rankin, formerly with Stanolind Oil & Gas Company, joined Houston Oil Company of Texas as assistant chief petroleum engineer.

Cliff Barber has joined the company as a staff geologist. Barber was formerly with the Union Oil Company of California.

•

Dr. George M. Saunders has been appointed medical director of Socony-Vacuum Oil Company, Inc., succeeding **Dr. Arthur E. Hoag,** retired.

Dr. Saunders has been medical director of the company's overseas operations for the past year.

•

Roland Dunkerley has joined Housh Drilling Company, Houston. He had formerly been drilling superintendent and district engineer for British American Oil Company, and before that was with Humble Oil & Refining Company in the Land and Geological department, Corpus Christi, and in the Production department at Freer, Texas. He is a graduate of Texas A. & M. College in petroleum engineering.

ASK THE ROYAL ABOUT CANADA'S OIL

Branches throughout Canada's oil-rich western plains. On-the-spot information available through E. B. Durham, Supervisor, Calgary, Alberta, or Head Office, Montreal

Assets exceed $2,334,000,000

We do not provide information on oil securities

THE ROYAL BANK OF CANADA

Over 750 branches in Canada and abroad

DEATHS

Walter B. Pyron, Brig. Gen., U. S. Army, retired, and a former vice president of Gulf Oil Corporation, died January 8 in San Antonio. General Pyron retired from Gulf last spring following 43 years service with that company. For 5½ years prior to his retirement he had maintained his headquarters in London, England, where he was in charge of production operations of Gulf subsidiaries in Europe and the Near East.

Following various positions of responsibility in the Gulf Production department, General Pyron was elected vice president of Gulf Refining Company of Louisiana in 1916, and three years later was elected vice president of Gulf Production Company and Gulf Pipe Line Company. In 1929 he was elected vice president of Western Gulf Oil Company and transferred to Los Angeles, where he was in charge of West Coast production operations. In 1935 he was elected a vice president of Gulf Oil Corporation and returned to Houston in charge of operations of the Houston Production and Pipe Line divisions.

General Pyron continued to serve in this capacity until he entered active military service in 1940. Following World War II, he returned to Gulf and was sent abroad to take charge of the London office.

•

Guy Robert Rawlins, Sr., 63, veteran employe of Humble Oil & Refining Company, died January 3 in Houston. He had been with the company more than 30 years.

•

Harry H. Warner, 48, comptroller for Phillips Petroleum Company, died December 14 in Bartlesville, Okla.

Ralph Clayton Holmes, 76, retired president and chairman of the board of The Texas Company, died December 24 at Orlando, Fla. He had been with the company more than 30 years when he retired in 1934. Holmes started in the oil business with Standard Oil Company at Oleander, N. Y., in 1895. After that he worked with Solar Refining Company at Galatea, Ohio, until 1902, when the late J. S. Cullinan, first president of The Texas Company, brought him to Port Arthur, Texas. He became president of the company in 1926. In April, 1933, he was elected chairman of the board, and he retired a short time later.

•

Jack F. L. Casburn, 38, staff assistant and staff writer for Mid-Continent Oil and Gas Association, died January 8 in Tulsa. A former Mid-Continent district editor for *The Oil Weekly*, West Texas staff writer and editor for Rinehart's Oil News, Casburn was also at one time an oil writer for the Tulsa *World*.

•

Dr. Chester Stock, 58, California geologist and paleontologist, died December 7 in Pasadena. Recently elected president of the Geological Society of America, Dr. Stock was chairman of the Division of Geological Sciences at California Institute of Technology. He was senior geologist with the U. S. Geological Survey from 1943 to 1945.

J. Perry Scranton, 57, president of Mikton Oil Company and vice president of Fifteen Oil Company, died January 4 in Houston. A veteran of 30 years as an independent operator, Scranton developed the Jeanerette, Charenton and LaFourche fields in Louisiana, the Newgulf territory, and was also among the first to drill in East and West Texas. He had been an oil writer on the *Fuel Oil Journal* before World War I.

•

Guy L. Waggoner, 67, Texas oil man and rancher, died December 11 in Vernon, Texas. He was a member of the family that established the Three-D oil empire.

•

Lawrence E. Smith, research director of the Independent Petroleum Association of America and oil writer, died January 6 in Washington, D. C. He formerly was Mid-Continent manager of *National Petroleum News* at Tulsa.

•

George W. Carr, 51, president of Carr Geophysical Company, Houston, died December 24. Carr had been president of the company since he founded it in 1946, and before that had been vice president of the General Geophysical Company. He was a graduate of Colorado School of Mines.

•

Cal M. Shugert, 55, independent equipment sales representative, died January 11 in Houston. He had formerly been associate with Jarecki Manufacturing Company.

•

Louis Roark, 60, geologist and Land department superintendent for Sunray Oil Corporation, died December 29 in Tulsa.

•

William Gilmore Smiley, Jr., 44, geophysicist for Sun Oil Company, died November 8 in Dallas. Smiley, a graduate of The Rice Institute, was section head in Sun's Seismograph department.

•

John H. Joy, 60, superintendent of the pipe line department of Magnolia Pipe Line Company, died December 29 in Houston. He had been with the company since 1923.

•

Alvin D. Whitman, Houston independent oil operator and drilling contractor, died January 3 in Denison, Texas. Whitman was a veteran of both World Wars.

•

Stanley M. McDonald, 35, assistant general manager of The Louisiana Land and Exploration Company, died December 11 in Midland, Texas. He was a graduate of Louisiana State University and had been with Louisiana Land and Exploration for the past eight years.

•

Ralph Talley, 62, Land department superintendent for Magnolia Petroleum Company, died December 12 in Dallas. He had been with Magnolia for more than 31 years and was superintendent of the Land department for 27 years.

•

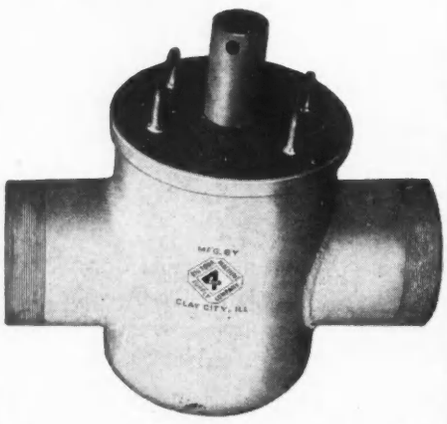
George B. Watson, 89, retired oil company official, died December 13 in Tulsa. He had been superintendent for the old Oklahoma State Oil Company and later for Texolan Oil Company.

BIG FOUR MACHINE 4 AND SUPPLY COMPANY

The new . . . BIG FOUR

STRAINER

Made to install on any pump or mud line.



CAN BE DISMANTLED, CLEANED AND REASSEMBLED IN LESS THAN 10 MINUTES!

Big Four's new suction strainer was specifically designed to eliminate the lost time of drilling contractors in shutting down pumps to clean out leaves, sticks and other foreign matter from slush pits. It's efficient in operation, quickly dismantled, cleaned and reassembled.

The strainer is composed of only four parts —the screen easily removable by unscrewing nut, removing nut and cap from the body of the strainer. Screen is held in place by slot on each side of the strainer. Strainer cap has hydraulic packing to seal on body; nut has hydraulic packing to seal on cap. Length overall 26"; weight 200 lbs. Available in 4"; 6⅝"; 8⅝" and 10¾" sizes. Special sizes furnished to meet requirements.

BIG FOUR MACHINE & SUPPLY CO.

MAIN OFFICE: 1013-14 HALES BUILDING, OKLAHOMA CITY, OKLAHOMA
CLAY CITY, ILL. Box 256
PAWHUSKA, OKLA. Box 477

BEAVER TOOL & MACHINE CO., MAYSVILLE, OKLAHOMA
Complete Warehouse Stocks Available at: C & W Machine Works Company, Great Bend, Kansas
Tillery and Parks, Odessa, Texas
EXPORT OFFICE: 233 Broadway, New York 7, New York

Companies in the News

HUGOTON GAS PLAINS AND OIL COMPANY, a new firm, has been organ-

J. Simon Fluor

Fred R. Tuerk

ized to produce and develop gas properties in the Mid-Continent. **J. Simon Fluor,** president, William R. Staats Company, and **Fred R. Tuerk,** chairman of the board, are the principal stockholders of the company which has purchased leases in proven gas fields totaling approximately 95,000 acres in the Oklahoma Panhandle and 20,000 adjoining acres in Kansas. Gas reserves are estimated in excess of 800 billion cubic feet. Other officers of the company are **Donald Royce,** vice president; **G. Hamilton Beasley,** treasurer; and **Dewey F. Gruenhagen,** secretary.

•

CONTINENTAL OIL COMPANY has set up a new district office in Casper, Wyo., for operations in the Sussex, Lance Creek and Big Muddy fields.

Personnel includes **Earl Y. Long,** district engineer transferred from Lance Creek; **J. W. Denny,** district superintendent from Lance Creek; **C. E. Robertson,** district clerk from Lance Creek; **R. C. Bartels,** assistant district superintendent with headquarters in Big Muddy.

•

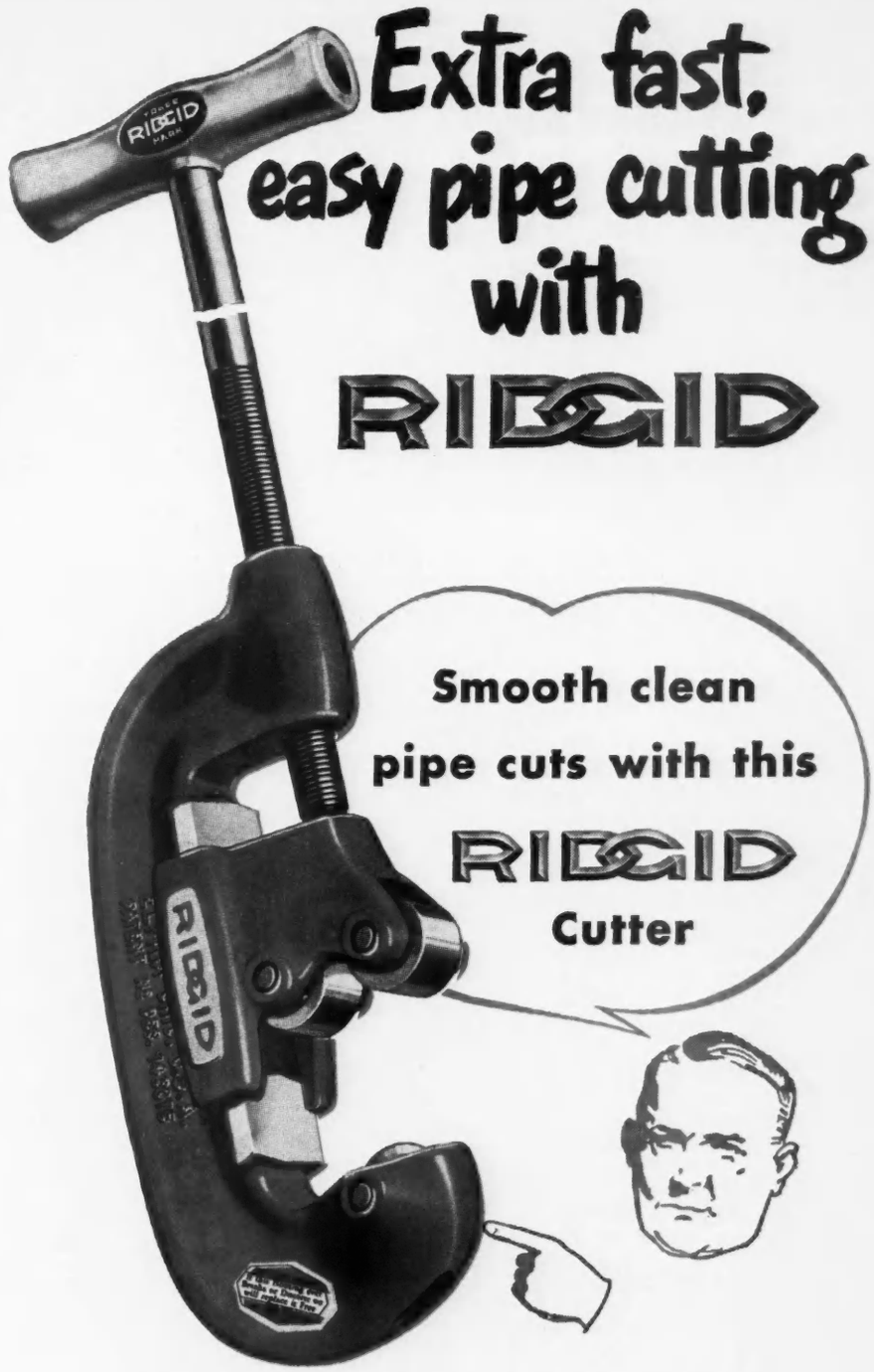
FALCON-SEABOARD DRILLING COMPANY, Tulsa, was awarded the Joseph A. Holmes Certificate of Honor for a safety record of ten years without a fatal accident. This is the first time the award has been made to a drilling company. **C. W. Seibel,** regional director, Sixth region, Bureau of Mines, made the presentation to **T. N. Law,** president of Falcon-Seaboard, **Charles Alcorn** and **J. L. Stess,** vice presidents of the company.

•

THE CARTER OIL COMPANY and Interstate Oil Pipe Line Company paid special contributions totaling approximately $1,110,000 to employes who are participants in the companies' voluntary thrift or savings plan. These year-end payments are in addition to regular contributions made to participating employes.

•

GULF OIL CORPORATION'S crude oil purchasing and pipe line transportation activities have been established as separate and primary departments of the company with **J. H. Russell,** vice president and veteran Gulf executive, heading both units and reporting directly to **S. A. Swensrud,** Gulf president. **Ben C. Belt** has become vice president in charge of the crude oil production activities formerly administered by Russell in the Houston division.



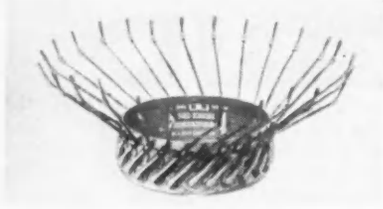
• It rolls right through any pipe with least effort, quick almost burrless cuts—factory tested, tracks perfectly. Special thin-blade cutter wheel for extra fast cutting—or heavy-duty wheel for extra long service. Guaranteed warp-proof special malleable housing. Five models to 6″ pipe; 4-wheel short-handle models for speedy cutting in tight places. For tops in clean easy pipe cutting, buy RIDGID Cutters at your Supply House.

RIDGID

★ Work-Saver Pipe Tools ★

THE RIDGE TOOL CO. • ELYRIA, OHIO

B and W
SCRATCHERS
AND
CENTRALIZERS
FOR
A GOOD CEMENT JOB



B and W MULTI-FLEX SCRATCHERS

❶ SCRATCH ON THE UP-STROKE won't "tear up" the hole while running in.

❷ RUGGEDLY CONSTRUCTED... Can "take it" on the casing rack and in the hole.

❸ LONG, STRONG, REVERSIBLE Multiple wire scratching fingers — 5 inches long — are flexible, sturdy and scratch thoroughly.

a GOOD combination with B and W LATCH-ON CENTRALIZERS

Strongest, Safest and Easiest to Install!

B and W Incorporated
* Well Completion Specialists *

WEST COAST — 3545 Cedar Avenue
Long Beach 7, California, Long Beach 4-8366
GULF COAST — P. O. Box 5266
Houston 12, Texas, Phone: WEntworth 6603

Associations

Seven Are Appointed Members Of Petroleum Council Panel

Seven prominent oil men have been appointed members of a National Petroleum Council committee to study the needs of the oil and gas industries for materials and chemicals.

The appointments, announced by Walter F. Hallanan, NPC chairman, include T. Sutter, Baker Oil Tools, Inc., Los Angeles; Reese H. Taylor, president of Union Oil Company of California, Los Angeles; W. K. Warren, president of Warren Petroleum Corporation, Tulsa; A. W. Thompson, Thompson-Carr, Inc., Houston; Jake L. Hamon, president of the Mid-Continent Oil and Gas Association, Dallas; D. A. Hulcy, president of Lone Star Gas Company, Dallas; and Munger T. Ball, maritime official, Port Arthur, Texas.

Hugh Stewart, director of the Oil and Gas Division of the Department of Interior, asked that the committee be named. "In addition to steel, there are other materials and chemicals such as copper, aluminum, zinc, cobalt, nickel and sulfur already in short supply or which may be in short supply in the near future," Stewart said.

1951 AIME Officers Will Be Installed at Annual Meeting

Willis McGerald Peirce, assistant to the general manager of the Technical department of the New Jersey Zinc Company, Palmerton, Penn., has been elected president of the American Institute of Mining and Metallurgical Engineers for 1951, and will take office February 20 at the Institute's annual meeting in St. Louis. At the same time, the election of Joseph L. Gillson, geologist with E. I. du Pont de Nemours & Company, Wilmington, Del., and Michael L. Haider, vice president and general manager, Production department, Imperial Oil, Ltd., Toronto, Ontario, as vice presidents and directors of AIME for three years was also announced.

Albert O. Rubel, vice president, Union Oil Company of California, will take office as a director of AIME. Richard W. French, vice president-production operations, Sohio Petroleum Company, Cleveland, is the new chairman of the Petroleum division.

Pipe Line Contractors Elect Favrot Association President

L. H. Favrot, of Houston Contracting Company, Houston, was elected president of the Pipe Line Contractors Association at the annual meeting of the association held in Houston. He succeeds Ray L. Smith.

Robert A. Conyes, of the R. A. Conyes Construction Corporation, San Pablo, Calif., and Robert Thomas, of Texas-Louisiana Contracting Company, Fort Worth, were elected vice presidents.

E. J. Mahoney, Jr., Mahoney Contracting Company, Lansing, Mich., was elected treasurer. Richard A. Gump was re-elected executive secretary.

Oklahoma City AAODC Group Elects Officers for 1951

Jack Abernathy, Big Chief Drilling Company, Oklahoma City, has been elected chairman of the Central Oklahoma Chapter of American Association of Oilwell Drilling Contractors for 1951. He succeeds Earle C. Flesher, Johnson & Flesher Drilling Company, Oklahoma City.

Other chapter officers include George B. Kitchel, vice chairman, and W. R. Ewert, secretary, both with Kerr-McGee Oil Industries, Inc., Oklahoma City.

Moore Is Chosen President

Gilbert P. Moore, Dallas consultant, has been elected president of the Dallas Geological Society. Vice president is Wallace Ralstrom, Sun Oil Company; secretary-treasurer, John C. Dunlap, DeGolyer and MacNaughton; and chairman of the executive committee, Albert E. Oldham, American Liberty Oil Company.

Foreign Guests shown at a recent meeting of the Los Angeles Chapter of Nomads are, first row, left to right, F. H. Kopp, Iraq Petroleum Company, Ltd.; R. J. Kettenburg, Asiatic Petroleum Corporation; R. E. Johnson, Anglo-Iranian Oil Company; E. J. Turner, Arabian American Oil Company. Second row: C. D. Schultz, Arabian American; L. W. Evinger, CIMA, Mexico; R. C. Enwall, Arabian American; W. T. Irvine, Anglo-Iranian; C. C. Sutten, Caribbean Petroleum Corporation; and F. G. West, Asiatic.

The 26th Annual Southwestern Gas Measurement Short Course will be held at the University of Oklahoma, Norman, Okla., April 10-12, and the program will be under the direction of James L. Griffin, Northern Natural Gas Company, Omaha, Neb. The Program Committee has planned a program which covers all phases of gas measurement work including gas accounting, metering, pressure regulation and instrumentation. Members of the General and Executive committees shown are, first row seated, left to right, T. S. Whitis, Griffin, Ben F. Worley, Dean W. H. Carson, R. O. Cox; second row, Roy S. Peace, Jr., W. A. Brewster, R. R. Suttle, W. H. Woods, R. M. Schofield, K. R. Tibbets, E. L. Stark; third row, left to right, T. J. Kirkpatrick, Dean Bruce, George E. Greiner, M. D. Gilbert, J. H. Satterwhite, George H. Smith, Charles A. Breitung.

ASME Petroleum Section Makes 1951 Committee Appointments

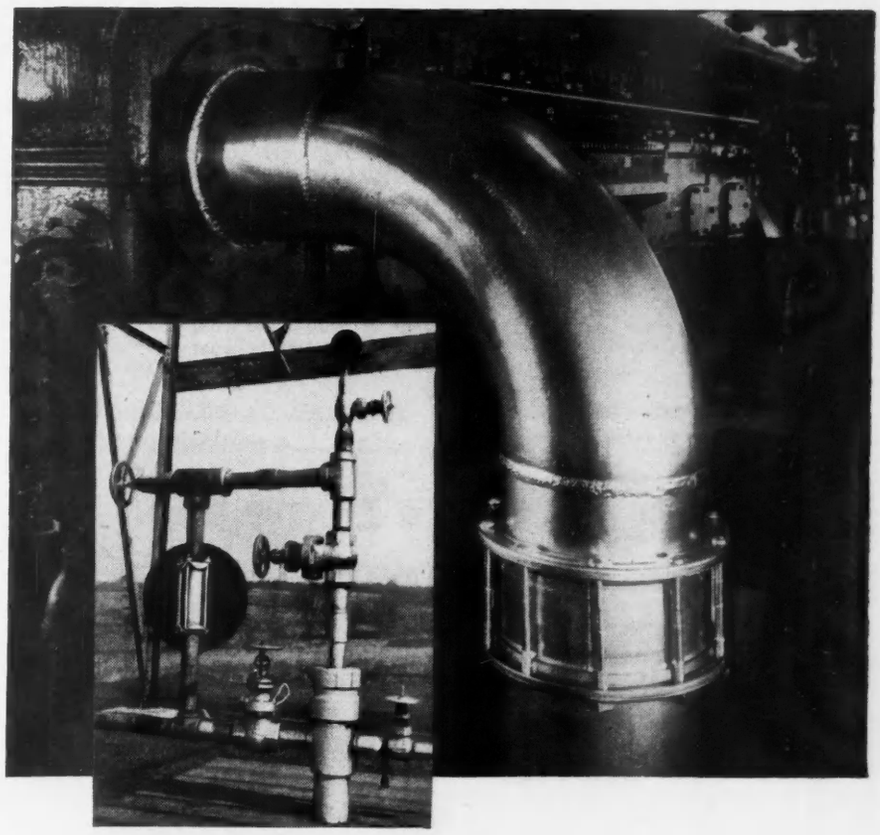
The ASME Petroleum division has announced its new committee appointments. J. M. Sexton, M. W. Kellogg Company, New York, replaces E. W. Jacobson as chairman of the division, and is succeeded as secretary by B. B. Morton, International Nickel Company, New York.

M. P. Watson, of United Gas Pipe Line Company, New Orleans, takes over the chairmanship of the Production Engineering Committee. F. V. Daasch, of Gulf Oil Corporation, Tulsa, will serve as vice chairman of this committee. Dr. E. N. Kemler, of the University of Minnesota, Minneapolis, has resigned the chairmanship of the Production Committee to accept a new appointment as research secretary for the division.

Plans are now being formulated for the Annual Petroleum Division Conference, to be held this year in Tulsa. It is possible that over 40 technical papers, dealing with mechanical design problems of the petroleum industry, will be presented.

Frisbie Is Chosen President Of Tulsa Chapter of AAODC

William S. Frisbie, Frisbie & Yancy Drilling Company, Tulsa, was elected chairman of the Tulsa Chapter of American Association of Oilwell Drilling Contractors for 1951. He succeeds B. E. Groenewold, Exploration Drilling Company, Tulsa. A. R. Olson, Olson Drilling Company, was elected vice president, and Robert D. Snow, H & S Drilling Company, was elected secretary-treasurer.



On equipment . . . or in the field . . .

DRESSERS *STAY TIGHT*

Wherever you have pipe to join, use Dresser Couplings and Long Sleeves. They make quick, dependable connections, even where pipe ends don't quite meet. Dressers are simple to join and give you a "Flexible-Tight" connection every time.

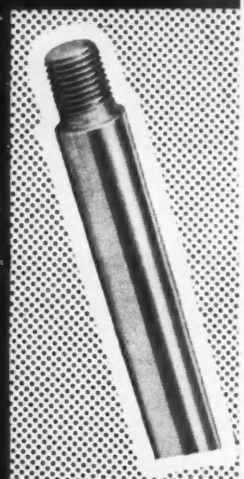
Get Dressers from your nearest oil field supply store, or at our Houston warehouse.

DRESSER "FLEXIBLE-TIGHT" COUPLINGS

ALTEN

Polished Rods

Made from prime quality steel 80,000 p.s.i., precision threaded for perfect fit and easy assembly. Accurate dimensions reduce packing replacement. All lengths —individually packaged.



ALTEN MAKES THE WORLD'S BEST PUMPING UNITS.

ALTEN

The Best in Oil Field Equipment

ALTENS FOUNDRY & MACHINE WORKS, INC.
Lancaster, Ohio

ASSOCIATIONS

Minckler Succeeds Taylor To Head Western Oil Men

Robert L. Minckler, president of the General Petroleum Corporation, was elected president of the Western Oil and Gas Association, succeeding Reese H. Taylor, president of the Union Oil Company of California, who had served as president for the past two years.

Other officers elected by the board of directors include William Reinhardt, vice president, Union Pacific Railroad Company, first vice president, William F. Humphrey, president, Tide Water Associated Oil Company, second vice president; L. K. Whittier, vice president, Belridge Oil Company, treasurer; John M. Peirce, vice president and general manager, and D. S. Kilgour, secretary.

Thirty-one incumbent members of the board were re-elected. John W. Hancock, executive vice president of the Hancock Oil Company of California, was elected to a directorship vacated by Will J. Reid, president of Hancock.

Short Course for Pipeliners Scheduled by Tulsa NACE

A short course on practical control of pipe line corrosion is scheduled for February 21-23 by the Tulsa Section of the National Association of Corrosion Engineers who conducted the first school of this type last February.

General chairman for the Tulsa school is J. N. Hunter, Jr., Service Pipe Line Company, assisted by Hugh A. Brady, Gulf Refining Company (field work), Yale W. Titterington, Dowell Incorporated (demonstrations-discussions), Maynard H. Jackson, Middle West Coating & Supply (hotel and transportation), and T. D. Williamson, Jr., T. D. Williamson, Inc. (publicity).

Sandidge Is Named President Of South Texas Geologists

Dr. John H. Sandidge, Magnolia Petroleum Company, has been elected president of the South Texas Geological Society. Vice president is James K. Rogers, Arkansas Fuel Oil Company; secretary, Roland F. Hodder, Stanolind Oil and Gas Company; and treasurer, Charles M. McDaniel, Jr., The Atlantic Refining Company. Robert G. Kurtz, The Ohio Oil Company, was elected a member of the executive committee.

Industrial Exposition to Be In Houston March 11-17

Equipment for all branches of the petroleum industry will be featured at the International Industrial Exposition to be held in the Coliseum at Houston March 11-17. Emphasis will be placed on the latest designs in tools and machinery, and the scientific developments that have made the oil industry the efficient enterprise it is today, according to E. G. Lenzner, general manager of the exposition.

CONTACT YOUR FAVORITE SUPPLY HOUSE

PARKERSBURG MACHINE CO. PARMACO PARKERSBURG, W. VA. U.S.A.

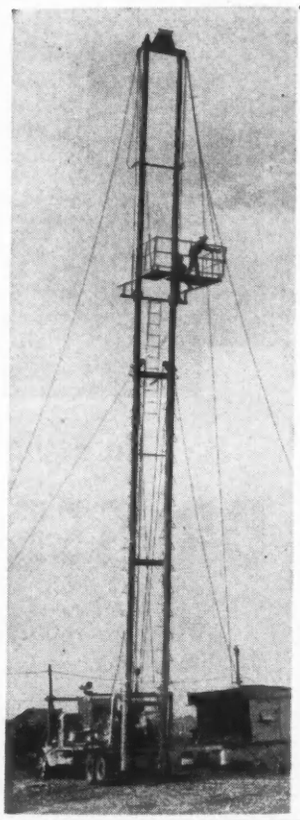
The House of Courteous Service

50 YEARS OF SERVICE

And on our 50th Anniversary we again invite you to Standardize on

PARMACO PRODUCTS

PARKERSBURG MACHINE COMPANY
PARKERSBURG, W. VA.



S & R

Custom Built

PORTABLE TELESCOPING POLE MASTS

This S & R double ladder mast is of heavy welded steel construction, and is fabricated of 10¾" pipe and 8⅝" pipe. Overall dimensions when erected 87 feet to crown support beam and 52' 0" when telescoped in traveling position.

Approximate weight of the complete equipment is 12,000 lbs.

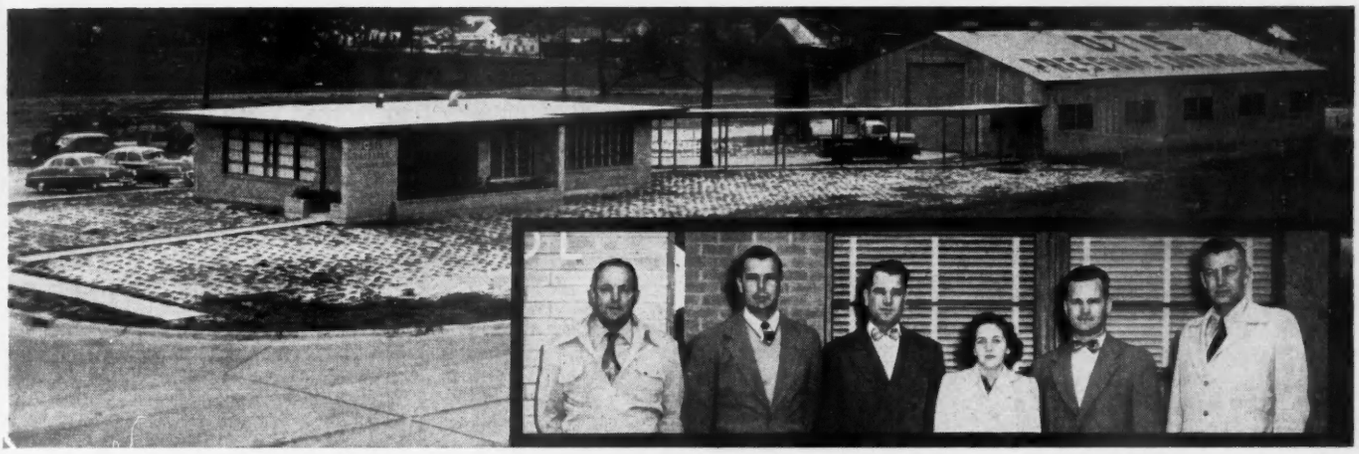
The complete assembly includes the (1) poles, (2) breakdown shaft assembly, (3) attached racking platform (which positions itself when poles are raised), (4) pole adjusting screws, (5) a sheave assembly to be mounted on truck or trailer for raising the poles, (6) and a four or five 24 inch sheave crown block for ⅞" line.
Available for truck, trailer, or skid mount.

For additional information write, wire, or phone

S & R TOOL & SUPPLY CO.
P. O. Box 1755 155 McCarty
HOUSTON 1, TEXAS
Export: 233 Broadway, New York 7, N. Y.

S-R TOOL SUPPLY CO. HOUSTON, TEXAS

EQUIPMENT AND SERVICE SUPPLIERS' NOTES



Otis Pressure Control's Houston division has moved into these recenty completed offices and warehouse at 2402 Broad Street at Gulf Freeway in Houston. Offices, sales rooms, and special quarters for Otis Tubing Caliper survey analyses are in the building on the left; equipment and tools are serviced and shipped in the warehouse building at right. In inset, from left to right, are Jack Rogers, assistant superintendent; D. E. Daffin, superintendent; Guy Gant, office manager; Mrs. Marian Pearson, secretary; Kenneth W. Robbins, caliper engineer, and Turner G. Garwood, Gulf Coast sales manager. Other Otis offices in the South Texas area are in Corpus Christi, Victoria, and Falfurrias.

Mission Manufacturing Appoints Faris Export Sales Representative

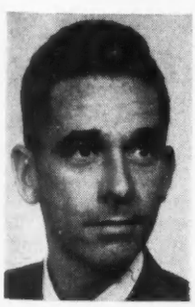
Mission Manufacturing Company, Houston, has appointed R. L. (Jack) Faris as export sales representative with headquarters in New York City, succeeding Jeff Tucker.

Faris spent the years from 1927 to 1937 in the oil fields, and in 1937 entered upon selling of oil well drilling equipment.

Faris takes charge of Mission export sales in the company's Silver Anniversary Year, which will be observed by the company throughout 1951.

Jorgensen Company Appoints Magee Houston District Assistant Manager

Earle M. Jorgensen Company has appointed W. H. Magee as assistant district manager of its Houston office. Magee joined the company in 1936 upon graduation from high school, and, with the exception of four years in the service, has been with the firm since that time. For the past several years he has represented Jorgensen in the Fresno, Calif., area.



W. H. Magee

Magee succeeds E. V. Brown, Jr., transferred to Dallas.

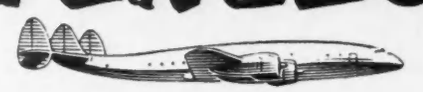
Tube Turns Appoints Distributors In Mid-Continent and California

Tube Turns, Inc., has appointed Bethlehem Supply Company and Bethlehem Supply of California as distributors of Tube Turn welding fittings and flanges.

Bethlehem Supply Company is a subsidiary of Bethlehem Steel Company and has its main offices in Tulsa. Its oil country stores and service organization cover Arkansas, Colorado, Illinois, Kansas, Louisiana, Mississippi, New Mexico, Oklahoma, Texas and Wyoming. G. A. Tompson is president and C. R. Zimmerman is executive vice president.

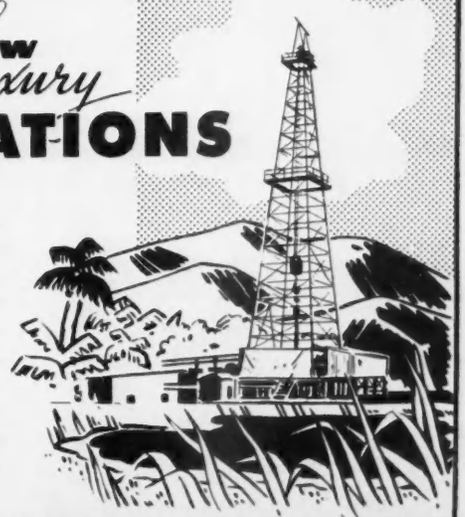
Bethlehem Supply Company of California is a subsidiary of Bethlehem Pacific Coast Steel Corporation. Its main offices are in Los Angeles and its oil country stores and service organization are located in eleven strategic areas in California. Wendell M. Jones is vice president and general manager and J. W. Hollingsworth is general manager of sales.

FASTEST SERVICE TO VENEZUELA



C&S NEW Luxury CONSTELLATIONS

Flights each way every day aboard C & S New Luxury Constellations through the New Orleans gateway offer 300-m.p.h., pressurized cabin service to the oil fields of Venezuela. One carrier service from Houston, St. Louis, Chicago and Detroit, with connections at New Orleans to and from Dallas, Tulsa, Los Angeles and San Francisco. For reservations call the nearest C & S ticket office or your Travel Agent.



CHICAGO & SOUTHERN AIR LINES

GENERAL OFFICES • MEMPHIS 2, TENN.

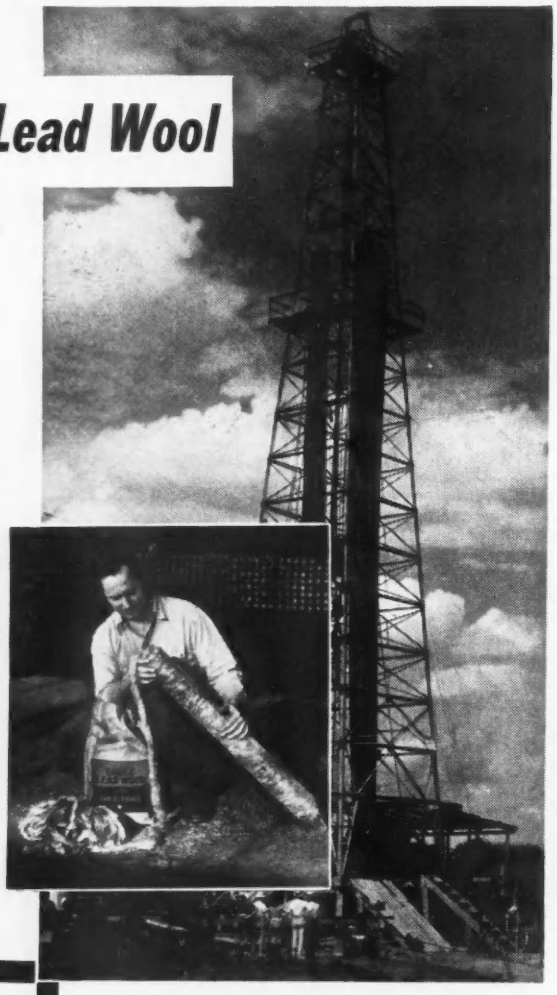
Ninety-five Years of Service to Hughes Tool Company are represented by these four veteran employes. Wade Hampton, Gulf Coast division sales manager of 32 years' service, and G. J. Meyer, assistant to the vice president-sales, a 33-year man, left, look on as the vice president-sales, M. E. Montrose, presents a 30-year service emblem to C. (Slim) Harrison, special field representative. Harrison, the fourth man to join Hughes' sales organization, had previously worked as a driller in several of the early Gulf Coast oil fields, including Spindletop and Goose Creek, and was later employed as a scout and drilling superintendent in the Louisiana fields.

Eagle-Picher Lead Wool

STOPS

bottom water

Rule out the risk of oil-wasting bottom water shutdown by tamping Eagle-Picher Lead Wool in the hole. The finely stranded, flexible metallic wool makes a water-tight plug that seals every crack and crevice. Comes in convenient 50-pound sacks—easy to place in special cartridge-shaped Eagle-Picher Wire Containers sized to fit all casings. Order through your jobber.



THE EAGLE-PICHER SALES COMPANY

Since 1843

Metallic Products Division, General Office, Box 777 East Chicago, Indiana

Cincinnati · Kansas City
East St. Louis · Dallas · Houston

Member: Lead Industries Association

2065-LW

EAGLE EP PICHER

These 3 Eagle-Picher Bearing Metals meet most requirements

1. **Dreadnaught** — for extreme speed and heavy-duty conditions.
2. **Outlasta** — for medium speed and average-load conditions.
3. **Durable** — for low speed and light-duty conditions.

H. K. Porter Company to Operate Chicago Electric Equipment Plant

H. K. Porter Company, Inc., Pittsburgh, has acquired the Delta Star Electric Company, Chicago, manufacturer of high voltage electrical equipment. The Delta Star Company designs and manufactures a variety of fittings, switches, insulators, conductors, supports and related equipment for control and transmission of electricity around central power stations, substations and transformers. No change in operations or management of Delta Star Electric Company is contemplated, according to T. M. Evans, president of H. K. Porter.

Independent Exploration Executive Resigns, Is Succeeded by Campbell

John H. Wilson, vice president and manager of Independent Exploration Company's North Texas office in Fort Worth, has resigned to open his own office as a consultant specializing in exploration programs. He will serve Independent Exploration Company as a consultant.

John H. Wilson

David B. Campbell, with Independent for 15 years and former supervisor of the Fort Worth office, is moved up to the position of district manager. He will be assisted by George H. Harrington, Jr., who has also served in Independent's Fort Worth office for several years. The Company recently moved into its new offices at 740 West Fifth Street in Fort Worth.

Cordiner Succeeds Charles Wilson As President of General Electric

Ralph J. Cordiner, New York, has been elected president of General Electric Company to succeed Charles E. Wilson, chairman of the new Defense Mobilization Board.

Cordiner has been with GE 24 years and has been manager of five of the company's departments during that period. He has been executive vice president and a director since 1949.

Wilson had completed 51 years of continuous service with the company in November.

A. O. Smith of Milwaukee Appoints Assistant Tubular Sales Manager

T. H. Creden, eastern district tubular products sales manager, New York, for A. O. Smith Corporation, was appointed assistant manager of A. O. Smith's Tubular division at Milwaukee. In his new assignment Creden will aid division manager Dennis F. McCarthy, whose responsibilities have been expanded to include those of vice president and general manager of A. O. Smith Corporation of Texas, operators of a new pipe mill at Houston. Succeeding Creden in New York is Walter D. Wood, who moved from the post of Boston branch manager, where he headed sales of A. O. Smith products.

T. H. Creden

J. J. Bohmann, coordinator of distribution and sales, will continue in this capacity in the handling of customer contacts.

Tulsa Attorney Trower Is Elected Bovaird Supply Company Treasurer

Thomas H. Trower of Tulsa has been elected treasurer of Bovaird Supply Company. A war veteran and attorney, Trower was graduated with an L.L.B. from the University of Oklahoma in 1942 and joined the Army that year. After the war, Trower was associated with John H. Poe, and since August, 1947, has been with the law firm of Williams, Boesche & McDermott. Trower has grown up in the oil business as the son of Harry A. Trower, vice president of Phillips Petroleum Company and chairman of the API Oil Industries Information Committee.

Thomas H. Trower

Roebling's Sons Company Appoints Three in Electrical Wire Division

Howard E. Maloney was made manager of sales of the Electrical Wire division of John A. Roebling's Sons Company. He has been associated with Roebling for the past nine years, starting as a salesman in the Seattle district office. In 1949 he transferred to the division's main sales office in Trenton as assistant manager, the position he held until his recent appointment.

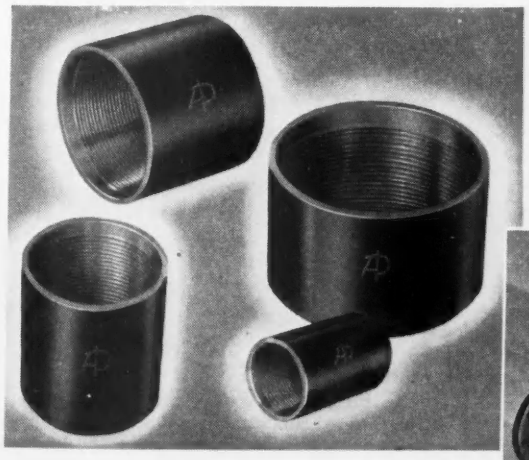
Frank T. Craven, a member of the electrical staff since 1936, was appointed assistant manager of sales. He was first employed as a salesman in the Philadelphia district office. For the past four years, he has been in charge of sales of coils, magnet wire, and bare and weatherproof products.

Roy H. Hainsworth became Eastern regional manager, with headquarters in Trenton. He joined the Roebling sales force in 1947, and has served in both the Denver and Chicago districts.

Prize Winner's Checks for submitting the entry, "Hardy Hal," in the recent Halliburton Portland Cement Company naming contest are presented to C. C. McCleary of Mission, Texas, center, and Jose Mora of Mercedes, Texas, right. William M. Taylor, left, Halliburton sales representative in the Rio Grande Valley, made the awards.

ACCURATE THREADING

...Key to the Dependability of HARRISBURG Couplings and Flanges



HARRISBURG Seamless Steel Pipe Couplings are manufactured to A.P.I. and A.I.S.I. specifications.

HARRISBURG Drop-Forged Steel Pipe Flanges are manufactured to A.S.A. standards.

THREAD ACCURACY and constant rigid inspection assure superior strength and endurance in *Harrisburg* Couplings and Flanges. Couplings are threaded on special machines to insure accuracy of form, height, angle, and lead. Flange threads are perfect in height, angle, taper, and gauging.

SEE OUR CATALOG IN THE COMPOSITE CATALOG

Consult our Oil Country Distributors or write Harrisburg for information

HOUSTON	LOS ANGELES	TULSA
Henry H. Paris, Distributor, Inc.	Howard Supply Company Republic Supply Co. of California	W. C. Norris, Manufacturer, Inc.

HARRISBURG STEEL CORPORATION
Harrisburg 8, Pennsylvania

Custom-Built Quality Products in Quantity
98 YEARS IN PENNSYLVANIA'S CAPITAL

BARRET

SPECIALIZING IN MAGNETIC SURVEYS

Contracts accepted for domestic and foreign projects, using the most improved instrumental and interpretative technique.

William M. Barret, Inc.

Consulting Geophysicists

GIDDENS-LANE BUILDING
SHREVEPORT, LOUISIANA

Red Top (Hydrostatic) BAILER

A QUICK, POSITIVE LOAD REGARDLESS OF FLUID LEVEL.
Ideal also for fishing small objects—widely used for drilling in (completing) wells, and for drilling cement or plastic plug overages.

REYNOLDS SPECIALTY COMPANY, INC.

SHREVEPORT, LOUISIANA, U. S. A.
Office: 804 Erie St., Phone 7-7511
If no answer call 2-2023, 7-4966, or 2-5842
Factory: 2134 Greenwood Rd., Phone 2-2023
COMPLETE INSURANCE COVERAGE

Louisiana:
JENA, Germany Machine Co.
RODESSA, Republic Supply Co.
SERVICE, phone Jack Willhoit, 4662 Lafayette, 7-7511 Shreveport, Sam Hattaway, Ph. 6263, 6731 Houma.

Arkansas:
EL DORADO, Cox Supply Co.

Oklahoma Service:
OKLAHOMA CITY, Dawson Service Co., Phone 54-7577

Texas:
CORPUS CHRISTI, A. S. Baylor, Phone 2-2461.
BORGER, Nichols Tool Company, phone 350.
KILGORE, Spain Brothers, phone 2981.
SERVICE, phone 3, Turnertown; 2981, Kilgore; TALCO, Talco Lumber Co.
SEMINOLE, A. C. Simmons, phone 404-J.

HOUSTON LABORATORIES

Analytical and Consulting Chemists

Hydrocarbon Gas Analyses, Reservoir Equilibria Studies for Crude and Condensate well, Waters, Brines, Corrosion and Industrial Analyses.

Phone CApitol 1319, Box 132, Houston, Texas

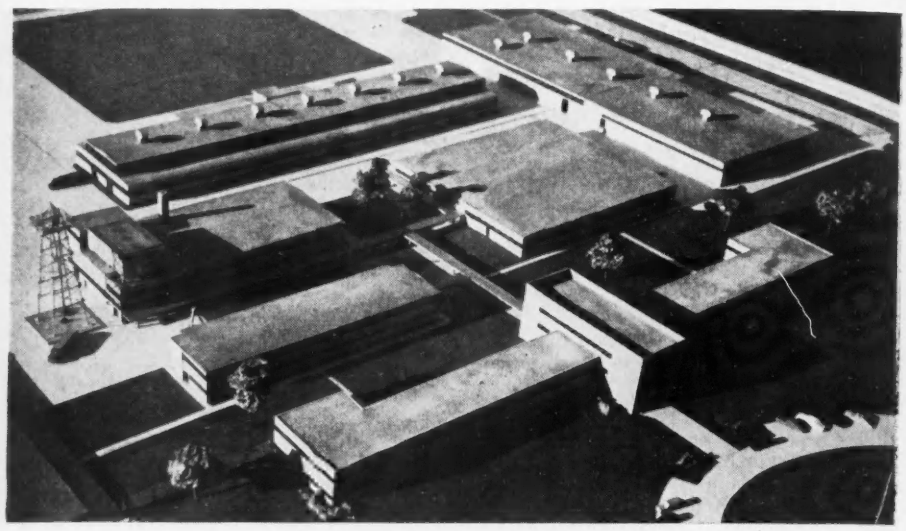
BE SURE TO READ

The Trading Post

Page 258

For Sales, Services

EQUIPMENT and SERVICE SUPPLIERS' NOTES



Model of Schlumberger's new Houston headquarters.

Ideco Appoints Roy H. Langford As District Manager in Oklahoma

International Derrick & Equipment Company has appointed Roy H. Langford district manager for Oklahoma, with offices in the Kennedy Building, Tulsa.

Roy H. Langford

Langford joined Ideco in 1948 as Tulsa city sales representative. He started in the oil business as a roughnecck in 1931, and joined an oil field supply company in 1935. He joined Ideco when he returned from service in the Air Corps. He is a graduate of Tulsa University.

Schlumberger Is Constructing New Home Office and Plant at Houston

Schlumberger Well Surveying Corporation has begun construction of a new $3 million home office and plant to be located on a 36-acre tract with 900 foot frontage in the 5000 block of the Gulf Freeway in Houston, Pierre Schlumberger, president, announced. Construction will be completed in approximately one year.

The new Schlumberger headquarters and plant will consist of six main buildings which will have a total of 235,000 square feet of floor area. The Administration Building will be a two-story wing building with a three-story center bay. It will have approximately 50,000 square feet of floor space. Other buildings will be the Engineering Building, Warehouse, Truck Shop, Instrument Production Shop and the Engineering Testing-Power Plant Building.

An 800-foot deep test well will be drilled just outside the testing laboratory. The well will be cased with a nonconductive porous material so that oil field electrical logging conditions can be simulated for testing of equipment. A second shallow test well will be drilled in which pressure can be built up to 12,000 psi and temperatures increased to above 300° F. This well will be capable of reproducing conditions in the deepest wells now being drilled. It also will be a part of the testing laboratory.

Rockwell Elects Board Member

J. Richardson Dilworth of Princeton, N. J., has been elected to the board of directors of Rockwell Manufacturing Company. Dilworth studied law at Yale University and is a member of the Connecticut Bar.

Halliburton Engineer Promoted

W. E. Hassebroek, formerly a development engineer, has been appointed technical supervisor of Hydrafrac Services for Halliburton Oil Well Cementing Company, with headquarters at Duncan, Okla.

in DALLAS
Best by Guest Test
LOMA ALTO HOTEL
4518 Lemmon Ave.
Wm. G. Martin, Mgr.
LAWN HOTEL
3718 Lemmon Ave.
John W. McCann, Mgr.
LAKEWOOD HOTEL
1818 Abrams Rd.
Paul C. Bryant, Mgr.
and now - the new LYNN HOTEL
101 Air Conditioned Rooms . . 3405 Gaston Avenue . . Charles A. Closson, Mgr.

The New Home for Stewart & Stevenson Services at 1624 4th Avenue, Lubbock, Texas, was recently opened in the West Texas area. The new store is larger and more modern than the old quarters. Stewart & Stevenson Services is distributor for General Motors Diesel Engines, Chrysler Engines, Continental Engines, and Gardner-Denver Pumps.

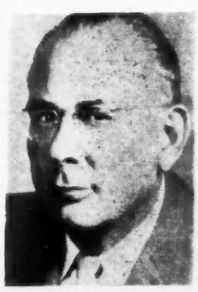
Houston Valve Manufacturer Names Hurley Assistant Sales Manager

The W-K-M Company of Houston, manufacturer of pipe line, christmas tree and general duty valves, has appointed Harvey L. Hurley as assistant sales manager. Hurley has been associated with the oil industry many years, more recently with Rockwell Manufacturing Company, and had his headquarters in Houston. He will give particular attention to W-K-M plans for the introduction of its products throughout all phases of the oil industry.

Harvey L. Hurley

Totco Export Sales Representative Will Visit South American Areas

E. E. (Bill) Williams has been transferred to the Export Sales department of Technical Oil Tool Corporation, Ltd., Los Angeles, and is now on an extended trip throughout oil producing areas in South America, Central America and Mexico. He is representing both Totco and the Lucey Export Corporation.



E. E. Williams

Williams has been in Bakersfield, Calif., for the past six years as a Totco sales representative.

Edward Promotes W. G. Mahlman To Post as Sales Office Manager

William G. Mahlman, for three years supervisor of order analysis for both Edward and Nordstrom valves, has been promoted to sales office manager of Edward Valves, Inc., East Chicago, Ind. He succeeds Herbert J. Rowe, who has been called back to the U. S. Marine Corps.

Mahlman attended the Carnegie Institute of Technology in Pittsburgh. For 12 years after, he was employed in sales activity in the Nordstrom Valve Division of Rockwell Manufacturing Company of Pittsburgh. He joined Edward in 1947.

Lawlor Advanced by Pittsburgh

E. W. (Red) Lawlor, sales-service representative of Pittsburgh Coke & Chemical Company, has been transferred from the Pittsburgh home office to the Tulsa office of the company's Protective Coatings division. Lawlor will assist Frank McNulty, Tulsa manager, in the Central West area. Lawlor has been in the coal tar products industry almost exclusively since his graduation from Pratt Institute in 1941.

Worthington Acquires Wintroath

Worthington Pump and Machinery Corporation, Harrison, N. J., announced the acquisition of Wintroath Pumps Inc., of Alhambra, Calif., and stated that the Wintroath Company will operate as a wholly owned subsidiary of Worthington, continuing under present management with Boyd Kern remaining as president.

★ Hot Applied Tar Base Coatings

★ Cold Applied Tar Base Coatings—Series 100

★ Alkyd Base Coatings—Series 200

★ Chlorinated Rubber Base Coatings—Series 300

★ Vinyl Base Coatings—Series 400

★ Phenolic Base Coatings—Series 500

Protective Coatings Booklet

Now Available

Booklet containing specific information on Pitt Chem Protective Coatings will be sent upon request.

See Your Nearest Pitt Chem Man

PROTECTIVE COATINGS DIVISION

W&D 3417

P C&C C

PITTSBURGH COKE & CHEMICAL CO.

GRANT BUILDING, PITTSBURGH 19, PA.

OFFICES: New York · Chicago · St. Louis · Tulsa · Houston · Los Angeles · San Francisco

Attend the N.A.C.E. Convention in New York City, March 13th to 16th

WORLD OIL'S Trading Post

CLASSIFIED ADS — SERVICES · PERSONNEL · USED EQUIPMENT

RATES: Regular Classified (undisplayed) set in this size type: 10 cents per word. If Box Number is to be used count an additional six words. Replies forwarded without charge. Situation Wanted: 5 cents per word. Display advertisements, set in suitably larger type with ruled border: $9.00 per column inch per insertion. Situation Wanted: $4.50 per column inch. **All classified ads payable in advance.** 10% Discount if 3 or more insertions are ordered at one time. **COPY DEADLINE:** 5th of month preceding date of issue. Send copy and checks to: Trading Post Section, World Oil, P. O. Box 2608, Houston, Texas

FOR SALE

Petrol Can Making Plant

for

Immediate Sale

Automatic 4 gal. tinplate petrol can manufacturing plant by Bliss. Capacity 10,000 cans per 8 hr. shift. This is a NEW PLANT and has never been used.

Full details (Codeword SMAVV) from:—

F. J. EDWARDS LIMITED

359-361 Euston Road, London, N.W.1 England

Telegrams & Cables: Bescotools, Norwest, London. Telephone: EUSton 4681 & 3771

■ FOR SALE: 9500 ft. electric conducting cable, new, never used, prestressed and preformed, 48,000 lbs. breaking strength. 2507 Mercantile Bank Building, Dallas, Texas.

■ **Well drills, spudders, rotaries, core-drills. All sizes new and used equipment. Tools, drill pipe, cable, pipe. Fishing tools rented. Everything for well drilling. Pressey & Son, Pueblo, Colorado.**

FOR SALE

12,500′ rig with Titan-Wilson drawworks; powered with three 350 HP Leroy motors. 2 18″ Oilwell mud pumps. 12″ QRC blowout preventer. 400 ton traveling equipment and swivel. Vibrator shale shaker. 136′ heavy duty derrick. Steel mud house; 2 steel mud tanks. 7½ KW light plant. 10,300′ of 4½ Reed extra hole supershrunk drill pipe which has drilled less than 30,000′; 6 6⅛ drill collars. Above equipment is modern and in first class condition. Contact Vernon Whiteley, Fair Foundation Building, Tyler, Texas; phone 2-2212.

WANTED TO BUY

■ WE WILL BUY Producing Oil Royalties. Send Particulars. Standard Security Co., 115 Broadway, New York 6, New York.

■ INDIVIDUAL will purchase producing royalties, oil or gas. James R. Curtis, Longview, Texas.

SITUATION WANTED

Drilling contractor operating in West Texas and New Mexico desires to contact small or medium-sized independent oil company who needs an operating manager. Personal interview desired. Twenty years experience in all phases of the oil industry. Address replies to Box 94-W, WORLD OIL, Houston 1, Texas.

Experienced woman geologist, 3 years with major company, desires subsurface or micropaleontology work in Caracus or other moderately sized city in South America. Box 9W, WORLD OIL, Houston, Texas.

MANUFACTURERS' AGENT

Well established manufacturers' agent contacting supply companies, gasoline plant and refinery engineering firms and oil companies in the Southwest is in position to do a good sales job on one additional line. Write Box 98-W, c/o World Oil, Houston.

■ Production Job Wanted. 7½ years experience as production foreman, 2 years pipe line gauger, 2½ years as drilling supt. Am at present pushing tools in Gulf Coast Area. 19 years in field. Experienced in both reverse circulation and cable tool work over and drill in. You show me the stake, I can drill the well and operate the lease. I want job I can live with my family. Would take lease job if house furnished. Will move for job. Age 37. Box 2-W, World Oil, Houston, Texas.

INVESTMENT OPPORTUNITY

SPOT CASH PAID FOR PRODUCING ROYALTY

Small to largest blocks in settled or old production only.
Oil Specialists Since 1934.

GERBER & CO.
120 Wall Street, New York, N. Y.

■ TRADE: Casing and tubing for ground floor interest in proven or semi-proven production. Principals only, send full details to Box 8W, WORLD OIL, Houston 6, Texas.

HELP WANTED

Position Available February 1, 1951, Assistant or Associate Professor with Masters degree or higher in Petroleum Engineering to teach reservoir engineering courses in rapidly growing school with excellent laboratory and other facilities. Qualifications will determine salary, but will be comparable to industry. Location Southwest. Box 6-W c/o World Oil, Houston, Texas.

EQUIPMENT and SERVICE SUPPLIERS' NOTES

Oil Base Adds Representative To Work in Ventura Sales Area

Oil Base, Inc., has appointed Charles Oxford of the Ventura, Calif., coastal area, for sales and service of Black Magic oil base drilling fluid, White Magic oil emulsion mud, chemicals and weight materials manufactured by Oil Base in Compton, Calif., and Houston.

Charles Oxford

Oxford was with Tide Water Associated Oil Company in California for two years before joining the Armed Forces in 1941. After his discharge he was with Baroid Sales Division of National Lead Company for seven years in California.

Arnall Succeeds Rhame as President Of Cincinnati Valve Manufacturer

Paul M. Arnall has been elected president of The Lunkenheimer Company, Cincinnati, to succeed Frank P. Rhame, resigned. Rhame, who had been with the company 32 years, continues as a director and in an advisory and consulting capacity with the 88-year-old valve firm.

Paul M. Arnall

Arnall joined Lunkenheimer last year, previously having been executive vice president and a director of Ohio Injector Company, Wadsworth, Ohio.

CORRECTION

The article, "Applications and Results of The Hydrafrac Process," by W. E. Hassebroek, page 133 of this issue, should have carried the following footnote: Hydrafrac—registered U. S. Patent Office.

NOTICES—SERVICES

Independent drilling company will trade closein acreage for 3000 feet or more of 10¾″ OD or 8⅝″ OD Casing. Well now drilling at the depth of 2,900 feet, in lime. Contact Portal Drilling Corp., 416 East Sixth St., Tucson, Arizona.

Use the Trading Post For Sale, Services

New Books, Maps and Movies

Oil Facts and Figures

"Facts About Oil," a compact collection of facts and figures on the domestic oil industry, has been published by the Department of Information of the American Petroleum Institute.

The 32-page booklet is an informative summary intended for use as reference and background by speakers, editors, students, writers and others needing a quick, handy guide to up-to-date information. It is not intended as a narrative story of petroleum.

The facts and figures are departmentalized under the following headings: oil its origin and progress; exploration, drilling; production; reserves; transporation; refining; supply and demand factors; marketing; uses of oil; cost factors; and oil and national security.

American Petroleum Institute, Department of Information, 50 West 50th Street, New York 20. $6 per hundred.

Petroleum and State Finance

A study to "make inquiry into the basic and underlying causes for the steadily declining tax revenues to the State of Texas from the petroleum industry" is reported in "The Texas Petroleum Industry and State Finances." The volume is intended primarily to provide background information and general analysis for the use of the Texas Legislative Council, its Study Committee on the Petroleum Industry, and the Texas Legislature, but also contains a great deal of information on state petroleum laws that would be of value to the operator.

Topics included in the discussion are a history of state regulation, market demand, the impact of foreign oil imports, and disbursement of oil and gas tax funds. The report is illustrated with charts, and abundant with tabular statistics.

Texas Legislative Council, State Capitol, Austin, Texas. 75 cents.

Woodford Black Shale

"Subsurface Woodford Black Shale, West Texas and Southeast New Mexico" is the seventh in a series of Reports of Investigations undertaken by the Bureau of Economic Geology of the University of Texas. Written by Samuel P. Ellison, Jr., member of the staff of the University's Department of Geology and consultant on the Bureau staff, the report consists of 20 pages with six text figures. The booklet describes the geographic distributions, lithology, thickness, and paleontology of the subsurface Woodford in the Permian Basin.

The University of Texas, University of Economic Geology, University Station, Box B, Austin 12, Texas. 35 cents.

International Labor

Two reports of the International Labor Organization, Petroleum Committee, Third Session at Geneva, have been published in booklet form. Report I deals with action taken in the various countries in the light of the conclusions of the Second Session of the committee; steps taken by the International Labor Office to follow up the studies and inquiries proposed by the committee; and recent events and developments in the world-wide petrolum industry. Report II discusses "Social Conditions in the Petroleum Industry."

International Labor Office, Washington Branch, 1825 Jefferson Place N.W., Washington 6, D. C.

Fuel Gas From Coal

Results of a survey of the technical and economic factors concerned in the production of fuel gas from coal, undertaken by Battelle Memorial Institute, are reported in a new 289-page book. Comparative cost data on other fuels is presented in the volume, which is entitled "Economics of Fuel Gas from Coal."

The result of a two-year research project, this book describes the characteristics of fuel gases and gives the technical features and estimated costs of typical processes for making various fuel gases from coal.

The reserves, production, and delivered cost of other fuels are reviewed and analyzed in individual sections dealing with oil, natural gas, coal and nuclear energy. Predictions are made of future costs and the future competitive situation among the various fuels.

McGraw-Hill Book Company, 330 West 42nd Street, New York 18. $5.

RED DEVIL

SLUSH PUMP VALVES

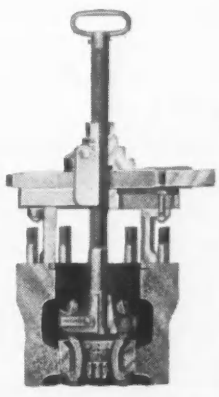
For high pressure abrasive service

In the manufacture of Red Devil Valves, particular emphasis has been given to HIGH PRESSURE ABRASIVE SERVICE at lowest possible operating costs. Their design is unique in simplicity, having only 5 parts. Valve and Seat are drop forged for maximum strength and processed for a deep high-carbon case to withstand excessive abrasive action. Seat has the least possible flow restriction and flat surface on bottom provides easy removal with Valve Seat Puller. "DIA-TEX" Inserts are Oil and Heat Resistant and can be reversed when worn on one side to double their long service life.

Write for Catalog No. P-110.

SPRING LOCK WASHER | VALVE INSERT PLATE | REVERSIBLE "DIA-TEX" VALVE INSERT | VALVE | VALVE SEAT

RED DEVIL VALVE SEAT PULLER



Provides a fast and positive means for pulling badly stuck valve seats by gripping the bottom rim of the seat. Eliminates the expense and hazards of removing seats with a cutting torch. All parts are made of highest grade alloy steel. Write for Catalog No. P-111.

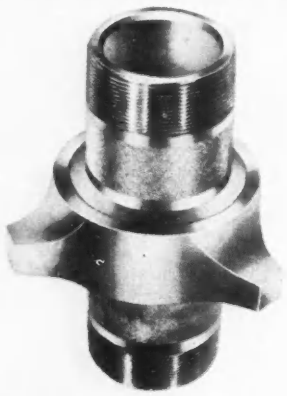
CONSULT YOUR COMPOSITE. For full information on Red Devil Valves, Pullers and other Products, see Composite Catalog or write for price catalogs noted above. Red Devil Products are available through your supply store.

OIL WELL MANUFACTURING CORP.

6008 S. Alameda Street • Los Angeles 1, California

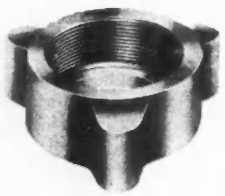
DRILLING EQUIPMENT MFG. CO.
DEMCO
OKLAHOMA CITY, OKLA. U.S.A.

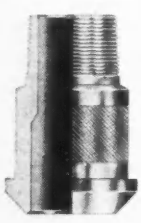
HYDRAULIC HOSE ADAPTERS



Under the most rigid tests DEMCO adapters have proved themselves most efficient, economical, foolproof and safe.
Designed to take the stress of high pressure at any depth and eliminate all possible resistance to flow. Made of high quality non-crystallizing steel. Precision machined to A.P.I. specifications and knurled for better grip. Outer surfaces electroplated to retard corrosion.

Designed for 3000 lbs. working pressure, 6000 lbs. test.





These Adapters and Couplings meet the requirements of all major swivel manufacturers, and will make up any combination or hook-up in the three or four-inch A.P.I. series for both swivel and standpipe.

Sold through your supply store.

DRILLING EQUIPMENT MFG. CO.
OKLAHOMA CITY, OKLAHOMA
PHONE 6-1342 845 S.E. 29th St. Box 4272

SQUEAKS from the BULLWHEEL

Observations

Elder Johnson of Squintberry Gulch says he has figured out why President Harry The-Red-Herring Truman wants Dean Acheson in his cabinet. "An ex-haberdasher likes to have a stuffed shirt around for atmosphere," says the elder.

There is one thing, though, that does perplex Elder Johnson. "If there ain't no machinery to take care of the situation when a president of U. S. goes nuts, there ought to be!" he declares.

Infiltration

We were a little late in reading our August 25 issue of *The New Yorker*, but the reading paid off. On page 44 we read an ad on Smernoff Vodka, which modestly admitted that its inclusion "inside the Moscow Mule" had captivated Hollywood. We hadn't been sure but we had thought that it was something from Russia which had captivated at least a *part* of Hollywood.

Worse Luck

There was a knock at the hotel room door. The woman inside the room whispered hurriedly to her boy friend. "That's my husband." Boy friend became a little excited himself, asked what to do.

"Jump out of the window," was the whispered reply.

Boy friend moved toward the window, took a look, rushed back with "Jump out of the window? You've forgotten we're on the thirteenth floor."

"Well," replied the flusterd female, "this is certainly no time to be superstitious."

Table d'Hote

American tourist in an Italian restaurant: "Hey, waiter, bring me two bottles of this Benozzo Vercelli listed here on the menu."

Waiter: "Sorry, sir, but that's the proprietor."

The Way It Seems

"Daddy, what's your birthstone?"
"Grindstone, my son, grindstone."

When You Put It That Way

First: "Say, old man, can you let me have five . . . ?"

Second: "No . . ."

First: ". . . minutes of your time?"

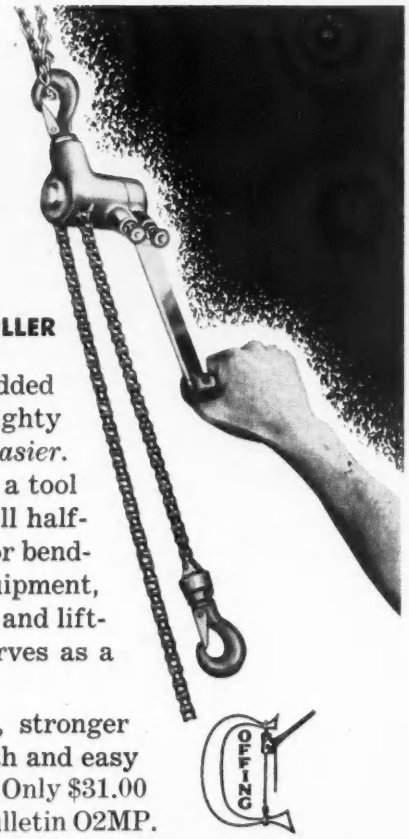
Second: ". . . trouble at all, old scout."

HERE'S

half a ton of pull

...TOOL-BELT SIZE

THE NEW 1000-LB. MIGHTY MIDGET PULLER



Combining easy portability with added pulling power, the new Coffing Mighty Midget does more jobs, does them *easier*. Only 9½ lb. in weight, it fits neatly in a tool box or hangs lightly on a tool belt. Full half-ton capacity gives it plenty of power for bending pipe, moving and repairing equipment, stretching guys — many other pulling and lifting jobs. Convenient 2-way handle serves as a lever or high-speed crank.

Equip your crews with these new, stronger Mighty Midgets. See how their strength and easy portability speed work in shop and field. Only $31.00 ($21.75 for 500 lb. model). Write for Bulletin O2MP.

Quik-Lift Electric Hoists • Hoist-Alls • Safety-Pull Ratchet Lever Hoists • Spur-Geared Hoists • Differential Chain Hoists • Load Binders • I-Beam Trolleys

COFFING HOIST COMPANY
Danville, Illinois

McCULLOUGH SERVICES:

A ELECTRIC WIRE LINE SERVICES

1. PERFORATING—Deepest penetrating burrless bullet and jet.
2. BRIDGING PLUGS—Drillable, expandable. McCullough and Baker.
3. MAGNA-TECTOR*—Locates stuck point of pipe, accurately, fast!
4. JET CASING CUTTERS*—World's fastest casing, tubing, drill pipe cutter!
5. JET BACK-OFF TOOL* and STRING SHOT—World's fastest way to recover stuck pipe!
6. JET BOTTOM HOLE CUTTERS*—Fragmentizes lost or stuck fish!
7. ELECTRONIC WEIGHT INDICATOR*—Supersensitive, small, light!
8. SONIC COLLAR LOCATOR*—Locates collars, liner tops, well bottom, etc.
9. MAGNETIC FISHING TOOL*—Surface indicates location and recovery of fish.

B ROTARY SERVICES

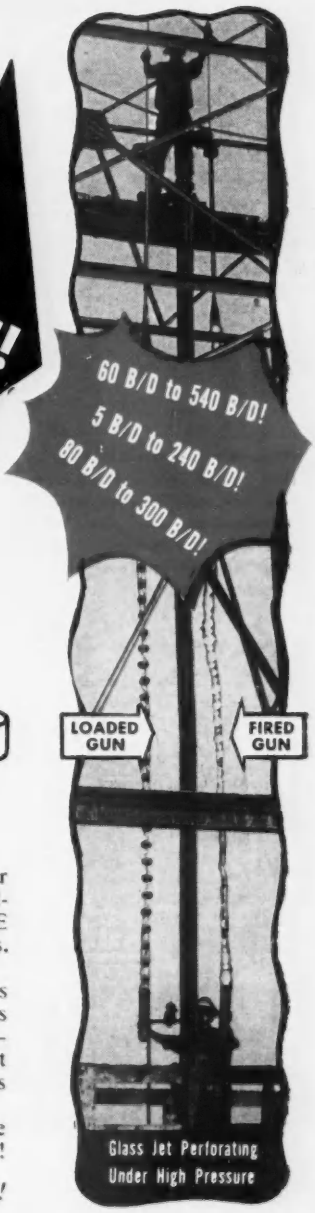
1. DOUBLE ACTING ROTARY JARS* and BUMPER SUBS—Reduces number of fishing jobs!
2. SAFETY JOINTS—Releases quickly in emergencies!
3. EXTERNAL DRILL PIPE CUTTERS—For all outside pipe cutting.
4. MECHANICAL LONG KNIFE INTERNAL CASING CUTTERS—All sizes pipe, tubing.
5. THIN WALL EXTERNAL CASING CUTTERS*—For outside cutting in small clearances!
6. ROTARY RELEASING OVERSHOTS—Completely encircles fish.
7. ROTARY RELEASING SPEARS—Engages or disengages at will.
8. GUN TESTER—Water shut-off, perforating, testing in one run.
9. JUNK BASKET—Crushable finger type. 5 minutes on bottom.

*Exclusive McCullough Services

PETROLEUM EQUIPMENT SUPPLIERS ASSOCIATION MEMBER

McCULLOUGH® GLASS JET PERFORATORS

Mean MORE OIL in the tank, even after all other methods fail!



MORE *Oil in the TANK means MONEY in the BANK...*

...and that's what you're after!

When you want cleaner, deeper, straighter holes, even after all other methods had failed to get results, there is only one choice—the new McCullough Glass Jet Perforator. Your reward—MORE OIL in the tank, MORE MONEY in the bank! No carrots or slugs, no splitting or sticking guns, trouble-free jet perforating for the FIRST time!

No matter how you look at it the McCullough Glass Jet Perforator makes sense. The emphasis is on the Glass Jet and not on the carrier. This permits the maximum safe charge of explosives where MORE POWER is needed—in small pipe in deep wells where several casing strings exist. The special heat treated glass units disentegrate completely. The retrievable strip carrier is pulled from the well.

Whatever your perforating problems—you're after MORE OIL in the tank. GET what you're after with the McCullough Glass Jet Perforator!

AVAILABLE NOW—See Your McCullough Service Man TODAY!

McCULLOUGH Tool Company

5820 South Alameda Street, Los Angeles 58, Calif. • 405 McCarty Street, (P.O. Box 2575) Houston, Texas
Export Office: Los Angeles, California

TEXAS: Snyder, Alice, Houston, Cisco, Corpus Christi, McAllen, Odessa, San Angelo, Tyler, Victoria, Wichita Falls. **OKLAHOMA:** Oklahoma City, Guyman, Healdton. **MISSISSIPPI:** Laurel. **NEW MEXICO:** Hobbs. **KANSAS:** Great Bend. **CALIFORNIA:** Los Angeles, Avenal, Bakersfield, Ventura. **LOUISIANA:** Houma, Lake Charles, New Iberia, Shreveport. **WYOMING:** Casper. **CANADA:** Edmonton. **VENEZUELA**—United Oilwell Service Co., S.A.: Caracas, Anaco, Maracaibo,

Mid-Continent NEWS and HUMOR?

MID-CONNIE RECOUNTS AN "INTERESTING" INDIAN YARN

When Mid-Connie made a flying trip to participate in the festivities opening Mid-Continent's new field store at Farmington, New Mexico, the feathers really flew . . . for the first time she ran into some real competition. Here's a "gal's eye-view" of what goes on at the opening of a new oil field supply store!

Humor is like gold—it's where you find it—Some of our friends say they find a "nugget" every now and then in the Humor Section of the Mid-Continent News—The company magazine published for employees and friends of the—

MID-CONTINENT Supply Company

General Offices Mid-Continent Bldg. FORT WORTH, TEXAS

"The World's Largest Independent Oil Field Supply Company"

SQUEAKS FROM THE BULLWHEEL

Upper Crust

Enchanted by the aura of fragrant perfume surrounding the tender young thing by his side, the college boy was moved to ask, "What kind of perfume are you wearing? White Shoulders?"

"Oh, sir," was the demure reply. "You aim too high for me."

Wilderness Was Paradise

Two explorers, bearded and soiled, met in the wilderness and crouched over a fire of brushwood.

Said the first: "I came out here because the urge to travel was in my blood. The drabness of towns irked me, and the ever-present smell of filth and exhaust fumes sickened my rebellious heart! I wanted to see the sun rise over mysterious horizons, hear the scared flutter of birds hitherto strangers to human footsteps, leave my footprints on sands unmarked before I came along, see Nature in the raw and share the primitive winderness! . . . Why did you come out here?"

Said the second: "My daughter is learning the piano."

Nationalism

Three men were standing on a street corner in North Africa. They were an Englishman, an Arabian and an American. Just then a beautiful dancing girl walked by. The Englishman said, "By jove!" The Arabian said, "By the prophet!" The American said, "By tomorrow night."

A Matter of Choice

A horse walked into a bar and ordered a Martini with two olives. After disposing of the drink the horse paid the bartender, said "Good afternoon, sir," and walked out.

"Say," said a well-oiled customer who had watched the proceedings, "isn't that a bit unusual?"

"Not at all," replied the bartender. "I frequently put two olives in a Martini."

Fall Guy

The battleship was in port and visitors were being shown around. The guide paused before a bronze plaque on the deck and with bowed head said: "That's where our gallant Captain fell."

Old Lady: "Well, no wonder. I nearly tripped over the darn thing myself."

Deflation

A Cub circled the airport asking to land with 19 passengers. Naturally, the pilot was branded a healthy liar, but was granted permission. When the plane landed, out stepped the pilot, followed by 19 tiny men from 18 inches to 2 feet high.

On being asked where he had found such an odd cargo, the pilot explained, "They're Texans with the brag taken out."

Class Line

"What's the matter?" asked the captain when the park policeman came in looking glum.

"It's that Mrs. St. John Astorbilt, sir, the woman who donated the bird bath to the park. She just called to say that it isn't to be used by sparrows."

Classic

"Every short story," said the journalism professor to his class, "should have reference to the Diety, a touch of royalty, and some mention of sex."

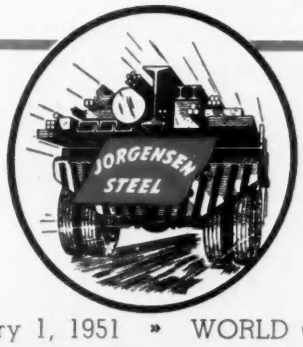
The following day an earnest student turned in this story:

" 'My God,' said the princess, 'take your hand off my knee!' "

Steel Problems?

Call Jorgensen First

Pity the poor bear. He has a steel problem, but can't call Jorgensen first. *You* can, however, and when you do, you'll find your Jorgensen warehouse a first aid station for steel or help with your steel problems. Jorgensen's stocks include carbon, alloy, stainless, tool and specialty steels. It's true that emergency demands have caused temporary shortages of some items, but remember that Jorgensen's men can help you select acceptable alternates. For steel or help with your steel problems *CALL JORGENSEN FIRST!*



EARLE M. JORGENSEN CO.
STEEL

HOUSTON	DALLAS	OAKLAND	SAN FRANCISCO	LOS ANGELES
5311 Clinton Dr.	2200 W. Commerce St.	1657 W. Grand Ave.	Ask Operator for	10650 S. Alameda
ORchard 1621	Riverside 1761	Higate 4-2030	Enterprise 10942	LUcas 0281

Scottie McBlock depends on a BIG PIN in an emergency

CAT LINE

SNATCH BLOCKS

FEATURE

- **LARGE DIAMETER CENTER PIN**

Shouldered to prevent shell from cramping or spreading under load.

Drop forged heat treated hooks, heads, links and shells.

High speed bronze bushings, Alemite lubrication.

All steel construction, sheaves designed for heavy duty service with manilla rope. Handy SELF LOCKING design for easy insertion of rope.

Write for Catalog on this and other McKissick Products

McKISSICK BUILDS A BETTER BLOCK FOR EVERY PURPOSE

McKISSICK

McKISSICK PRODUCTS CORPORATION

SQUEAKS FROM THE BULLWHEEL

"Never mind the straw, Ed—we've got the pump working now!"

Explanation in Full

An army sergeant was home on a furlough and his wife told him it was high time he told Junior about the birds and the bees.

"He's 11 years old," she said, "and no telling what trouble he'll get into."

So the reluctant father got his son into a room and said: "Son, you know where babies come from?"

"Why, of course, Pop," said Junior. "I've known that for years."

"Thank Heaven," sighed the relieved parent. "Well, it's exactly the same with birds and bees."

The Straits of It

One of the saddest stories we ever heard concerns the poor fellow who spent so much courting a girl that everyone now says he married her for his money.

Life Gets Tedious

One of our oil equipment friends in California complains of a "breaking out" in the joints, but he can't decide which joint he has been breaking out in because he has been in so many of them! Poor fellow, he has had a backache and the doctors gave him the medicine for that. This fixed him up but gave him stomach trouble. They then shot him in the rear with penicillin which made his stomach feel all right, but made his back end hurt. What a life!

Dear Departed

Most women would like a man who loves her and leaves her—provided he leaves her enough.

Q.E.D.

"My girl has two of the most beautiful legs in the world."

"How do you know?"

"I counted them."

Final Blow

"Woe is me! My wife left me, the house burned down, my daughter eloped with a circus acrobat; the bank called in my loan; I lost my job, and the Dodgers lost four to three. Just imagine! Four to three in the ninth!"

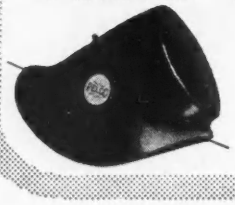
Destination

"Do you know where bad little girls go?" the psychiatrist asked the four-year-old.

"Sure. Everywhere!" was the reply.

Specify **PELCO** Welding Saddles

PELICAN WELL TOOL & SUPPLY CO.



P. O. Drawer 1108
Shreveport (84), La.

SEE YOUR NEAREST SUPPLY HOUSE